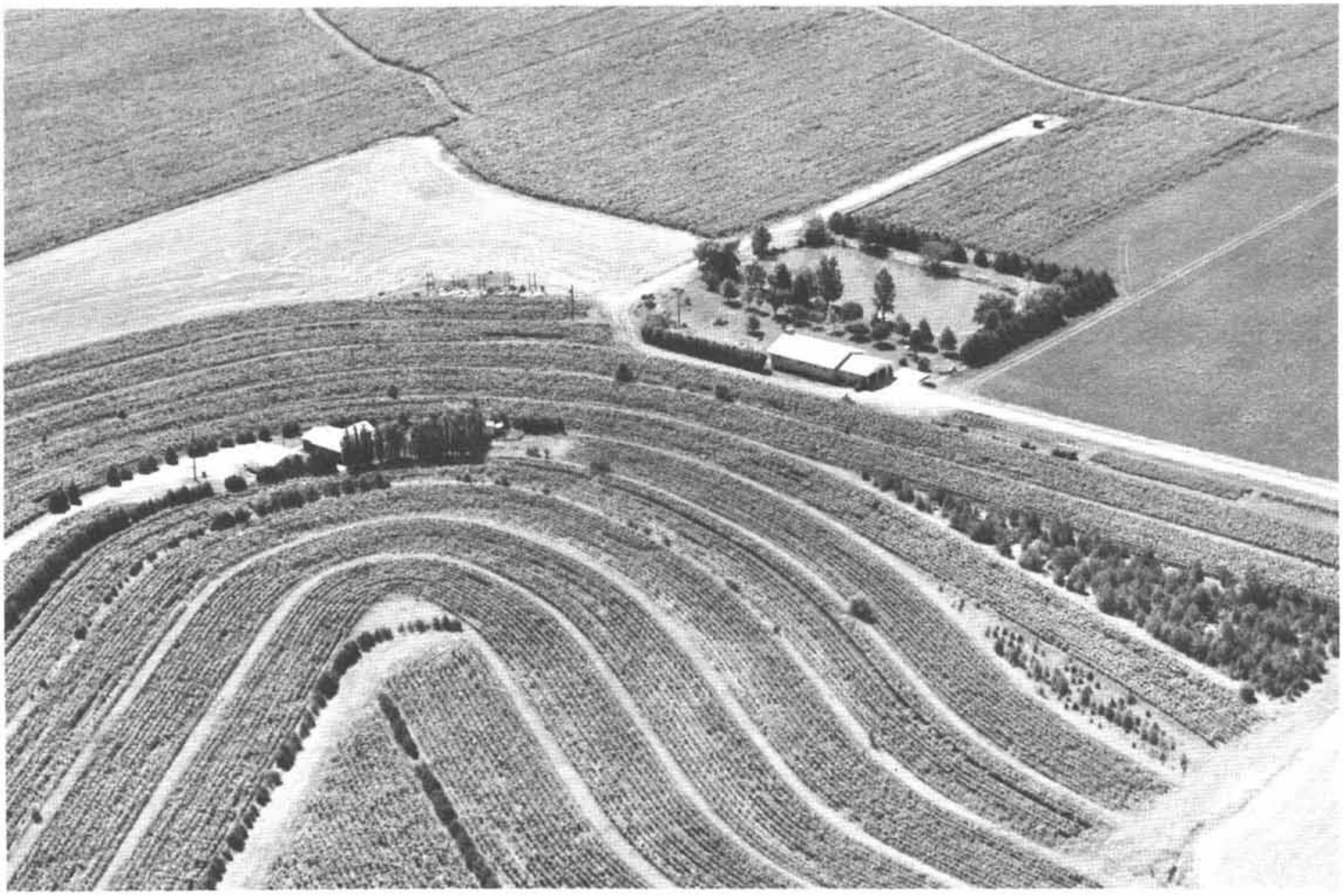
SOIL SURVEY OF

Adams County, Nebraska



United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of Nebraska
Conservation and Survey Division

Issued November 1974

Major fieldwork for this soil survey was done in the period 1961–69. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division. It is part of the technical assistance furnished to the Little Blue Natural Resource District and the Upper Big Blue Natural Resource District.
Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Adams County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classifications of each. It also shows the page where each soil is described and the page for the range site and windbreak suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the windbreak suitability groups.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife and Recreation."

Ranchers and others can find, under "Management of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Foresters and others can refer to the section "Use of the Soils for Woodland and Windbreaks."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Adams County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

***Cover:* Typical cultivated area of the Hastings-Holder association. Row crops in this association are mostly gravity irrigated, but the moderately sloping soils need to be contour bench leveled (foreground) to help prevent water erosion. Courtesy of Richard Hufnagle, photographer.**

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Issued November 1974

SOIL SURVEY OF ADAMS COUNTY, NEBRASKA

BY LARRY G. RAGON, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

ADAMS COUNTY is in the south-central part of Nebraska (fig. 1). It has a total area of 562 square miles, or 359,680 acres. Hastings, the largest town and county seat, is in the northeastern part of the county.

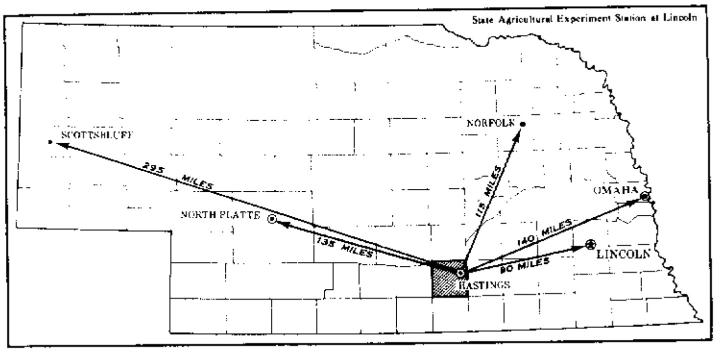


Figure 1.—Location of Adams County in Nebraska.

The county is in the Central Loess Plains section of the Great Plains. Most of the area is nearly level to low, rolling loess plains that are dissected by small drainageways. An area of sloping loess hills occurs along the Little Blue River valley in the southern part of the county. The rest of the county consists of undulating sandhills and nearly level bottom lands and stream terraces. Nearly all the soils are deep, and they formed in calcareous loess, eolian sands, or mixed silty and sandy alluvium.

Farming in the county is based mostly on growing cash-grain crops and raising livestock. More than 75 percent of the acreage is cultivated, and 16 percent is in rangeland. Less than 1 percent of the county is in woodland and windbreaks. The lack of seasonal rainfall makes irrigation from deep wells important in the county. About one-fourth of the acreage in the county is irrigated. The principal irrigated crops are corn and grain sorghum. Wheat, grain sorghum, and alfalfa are the principal dryland crops. Livestock consists mainly of beef cattle and swine.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Adams County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of soil material and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Hastings and Valentine, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Holder silt loam, 3 to 7 percent slopes, is one of several phases within the Holder series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Adams County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Hersh-Kenesaw complex, undulating, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Lex and Alda soils is an undifferentiated group in this county.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Silty alluvial land is a land type in this county.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Adams County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Adams County are discussed in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 6, the words, "silty and loamy" refer to the texture of the surface layer.

1. Hastings-Holder association

Nearly level to moderately sloping, deep, silty soils on uplands

This association consists of well-drained soils on loess plains. The area of this association is 153,580 acres, or about 42 percent of the county.

Hastings soils make up 47 percent of this association; Holder soils, 37 percent; and minor soils, the remaining 16 percent (fig. 2).

Hastings soils are nearly level. They have a surface layer of dark grayish-brown silt loam. Their subsoil is mainly grayish-brown and brown heavy silty clay loam. The underlying material is very pale brown, calcareous loess of silt loam texture.

Holder soils are nearly level to moderately sloping. They generally have a surface layer of gray and dark-gray silt loam. Their subsoil is mainly grayish-brown light silty clay loam. The underlying material is light gray, calcareous loess of silt loam texture. In severely eroded areas, the surface layer is commonly grayish-brown silty clay loam.

Minor soils of this association are the Hord, Butler, Fillmore, and Hobbs series. Hord and Butler soils are nearly level and are on uplands. Fillmore soils are in depressions on the uplands. Hobbs soils are on the bottoms of draws in the uplands and are occasionally flooded.

This association is mostly cultivated. About one-third of it is irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. The native areas support stands of mid and short grasses. Controlling erosion, maintaining soil tilth and fertility, and conserving moisture are the main concerns of management. Farms are mostly of the cash-grain type, but farmers use some of the grain to

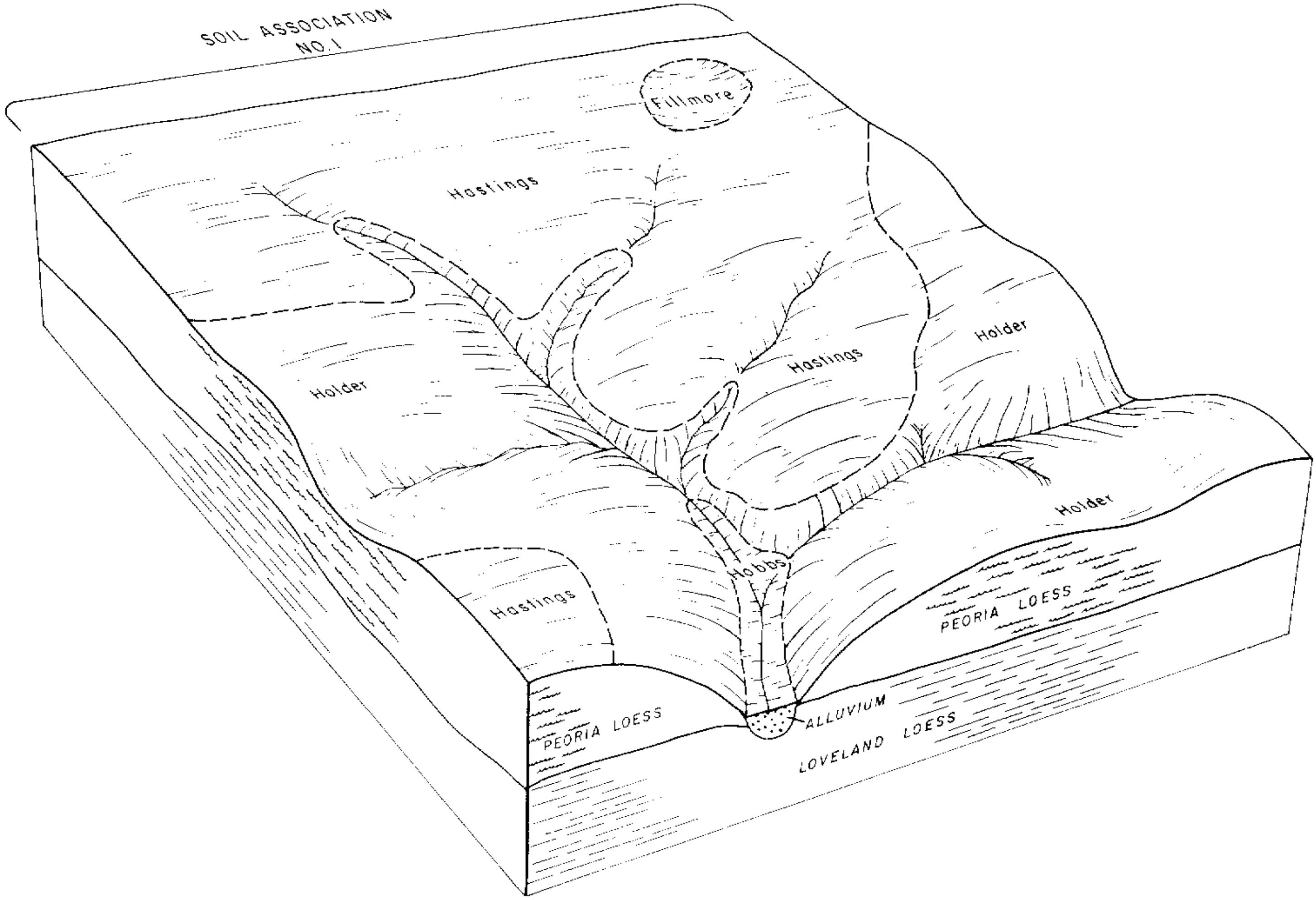


***Figure 2.*—Typical pattern of soils and underlying materials in association 1. Severely eroded Holder soils are mostly along drainageways on uplands.**

fatten livestock. Nearly all farms have access to good gravel or hard-surface roads.

2. *Hastings-Crete association*

Nearly level to gently sloping, deep, silty soils on uplands

This association consists of well drained and moderately well drained soils on loessal uplands. The area of this association is about 30,300 acres, or 8 percent of the county.

Hastings soils make up 70 percent of this association; Crete soils, 15 percent; and minor soils, the remaining 15 percent.

Hastings soils are nearly level to gently sloping. They have a dark grayish-brown silt loam surface layer. Their subsoil is mainly grayish-brown and brown heavy silty clay loam. The underlying material is very pale brown, calcareous loess of silt loam texture.

Crete soils are nearly level. They have a surface layer of gray and dark-gray silt loam. Their subsoil is mainly grayish-brown silty clay. The underlying material is light gray, calcareous loess of silt loam texture.

Minor soils of this association are the Holder, Butler, Fillmore, Scott, and Hobbs soils. Holder soils are moderately sloping to strongly sloping and are along the sides of drainageways on uplands. Butler soils are nearly level. Fillmore and Scott soils are in upland depressions. Hobbs soils are on the bottoms of draws in the uplands and are occasionally flooded.

Most of the acreage in this association is cultivated. About two-fifths of the association is irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. The small acreage that is in native grass supports stands of mid and short grasses. Controlling erosion, maintaining good soil tilth and high fertility, and conserving soil moisture are the main concerns of management. Farms are mostly of the cash-grain type, but farmers use some of the grain to fatten livestock. Nearly all farms have access to good gravel or hard-surfaced roads.

3. *Kenesaw-Coly association*

Nearly level to steep, deep, silty soils on uplands

This association consists of well-drained to somewhat excessively drained soils on loessal uplands. Much of it is hummocky. The area of this association is about 65,400 acres, or 18 percent of the county.

Kenesaw soils make up 80 percent of this association; Coly soils, 8 percent; and minor soils, the remaining 12 percent (fig. 3).

Kenesaw soils are nearly level to moderately sloping. They have a grayish-brown silt loam surface layer. The underlying material is light-gray, calcareous loess of silt loam texture.

Coly soils are strongly sloping to steep and are on the sides of drainageways on uplands. They have a thin surface layer of dark grayish-brown silt loam. This is underlain by very pale brown, calcareous loess of silt loam texture.

The minor soils of this association are the Hersh and Rusco soils and Silty alluvial land. Hersh soils formed in eolian sands on uplands. Rusco soils are in low areas or shallow depressions. Silty alluvial land is on bottom lands along the major drains and is frequently flooded.

Most areas of the soils in this association are cultivated. About one-fifth of the association is irrigated. Wheat, grain sorghum, corn, and alfalfa are the major crops. Controlling water erosion and soil blowing on the irregular, hummocky topography and improving soil tilth and maintaining high fertility are concerns of management. Conserving soil moisture is a concern under dryland management. The areas of native grass support mid and short grasses. Farms are mainly of the cash-grain type, but farmers use some of the grain to fatten livestock. Nearly all farms in the area have access to good gravel or hard-surface roads.

4. *Holder-Geary-Coly association*

Moderately sloping to steep, deep, silty soils on uplands

This association consists of well-drained to somewhat excessively drained soils on the sides of intermittent drainageways. It occurs on breaks of the uplands along the Little Blue River and its tributaries (fig. 4) and along the West Fork of the Big Blue River. The loessal uplands are deeply dissected by the streams, which give the areas a rolling topography. The area of this association is about 52,500 acres, or 15 percent of the county.

Holder soils make up 54 percent of the association; Geary soils, 20 percent; Coly soils 9 percent; and minor soils, the remaining 17 percent.

Holder soils are moderately sloping to strongly sloping. They have a surface layer of gray and dark-gray silt loam in uneroded areas, and commonly of grayish-brown light silty clay loam in severely eroded areas. Their sub-

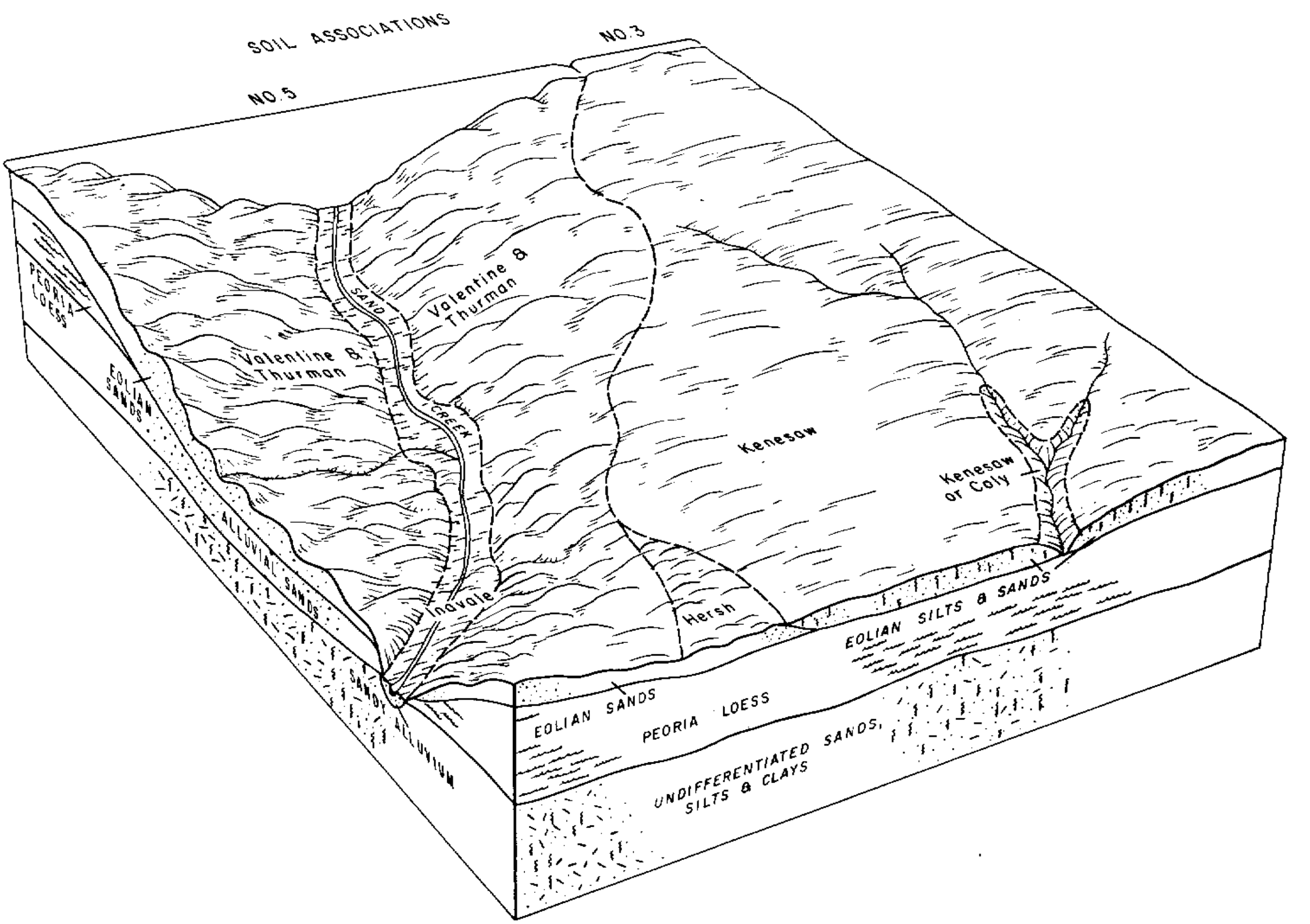


***Figure 3.*—Typical pattern of soils and underlying materials in associations 3 and 5.**

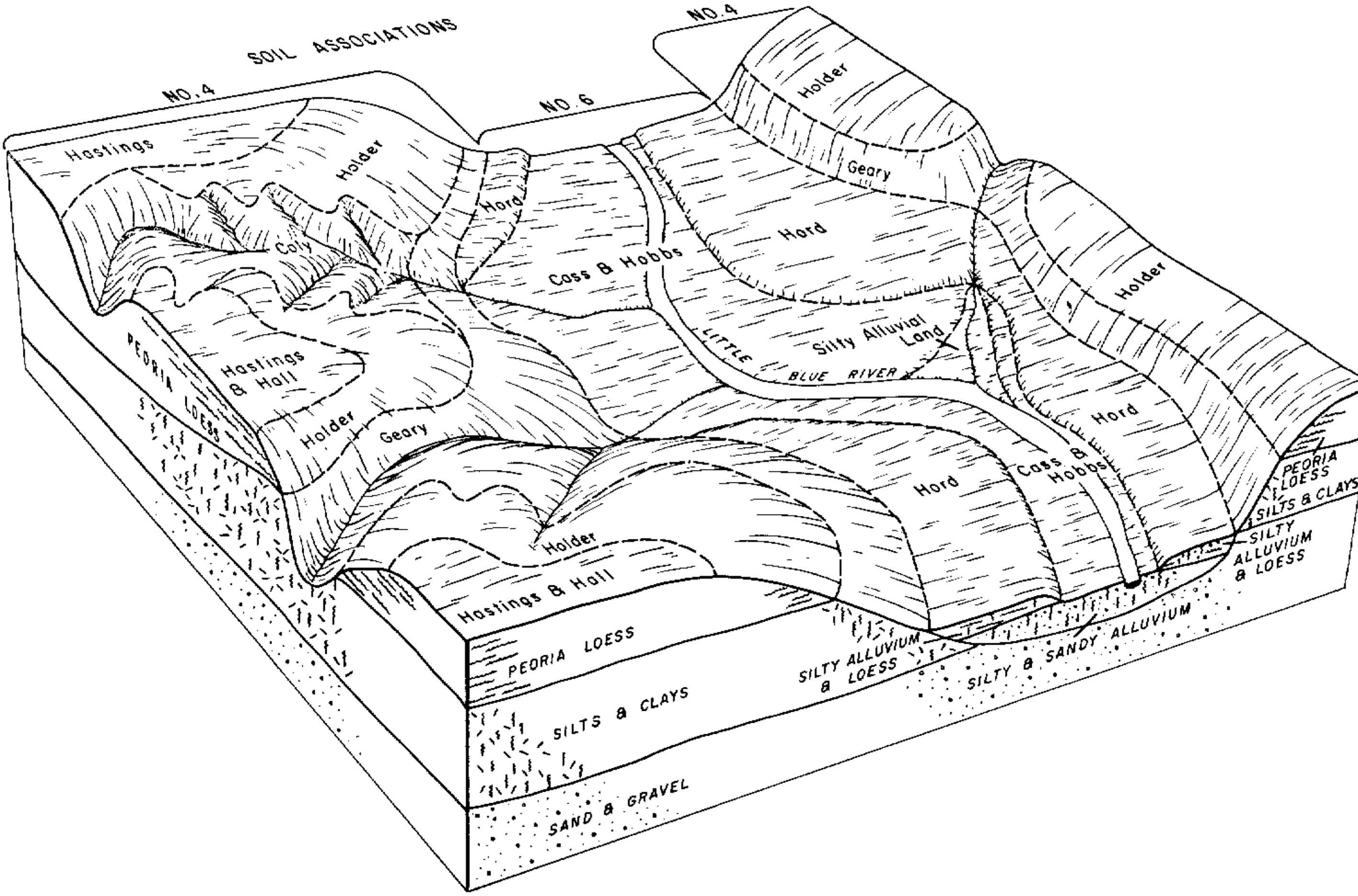


***Figure 4.*—Typical pattern of soils in associations 4 and 6.**

soil is mainly grayish-brown light silty clay loam. The underlying material is light-gray, calcareous loess of silt loam texture.

Geary soils are moderately sloping to steep. These soils have a surface layer of dark grayish-brown silt loam in uneroded areas, and commonly of brown silty clay loam in eroded areas. Their subsoil is mainly brown silty clay loam. The underlying material is light-brown, calcareous loess of silty clay loam texture.

Coly soils are steep. They are on the sides of intermittent drainageways. They have a thin surface layer of dark grayish-brown silt loam. The surface layer is underlain by very pale brown, calcareous loess of silt loam texture.

The minor soils of this association are the Hobbs, Hastings, and Hall soils. Hobbs soils are on the bottom of draws in the uplands and are occasionally flooded. Hastings and Hall soils are nearly level and are on ridgetops between the drainageways. Breaks-Alluvial land complex and Silty alluvial land are along some of the major drainageways.

The acreage in this association is used mostly for cultivation, but about 20 percent of it is in native grass. The soils in cultivated areas are mostly dryfarmed, but a few areas of the nearly level to gently sloping soils on ridgetops are irrigated. Wheat, grain sorghum, and alfalfa are the major crops grown. The main limitations of this soil association are surface runoff and soil erosion. Maintaining high soil fertility and conserving moisture are the main concerns of management. The areas of native grass support stands of mid and short grasses. Farms in this association are a combination of the cash-grain and livestock types. Nearly all farms have access to good gravel or hard-surface roads.

5. *Valentine-Thurman association*

Undulating to rolling, deep, sandy soils on uplands and stream terraces

This association consists of excessively drained and somewhat excessively drained soils that formed in sand deposited by wind (see fig. 3, p. 4). These soils are commonly referred to as the Sandhills. The areas of this association is about 14,300 acres, or 4 percent of the county.

Valentine soils make up 76 percent of the association; Thurman soils, 10 percent; and minor soils, the remaining 14 percent.

Valentine soils are rolling. They have a thin surface layer of grayish-brown loamy fine sand. The underlying material is pale-brown fine sand.

Thurman soils are undulating and are on stream terraces and uplands. They have a surface layer of dark gray loamy fine sand. The underlying material is very pale brown loamy fine sand.

The minor soils of this association are the Inavale and Hersh soils. Inavale soils are nearly level to gently sloping and are on bottom lands along major streams and small drains in the sandhills. Hersh soils are on the uplands near the edge of the Sandhills.

About 50 percent of this association is in native grass and is used for grazing. These areas support stands of mid and tall grasses. Most of the rest of the association is cultivated. Grain sorghum, corn, wheat, and alfalfa are the main crops. Control of soil blowing, maintaining high fertility, and conserving moisture are the main concerns of management in cultivated areas.

Only a few farmsteads are in this association. Generally, they are near the edge of the Sandhills, and the farms include other land that is more suitable for cultivation. Most of these farms are used for combined ranching and farming. Sandhills are mostly owned and used by farmers and ranchers who live outside this association. Good gravel roads are very few. Trails are on some section lines.

6. Hord-Cass-Hobbs association

Nearly level to gently sloping, deep, silty and loamy soils on stream terraces and bottom lands

This association consists of well-drained soils on bottom lands and stream terraces along the Little Blue River and its major tributaries. The soils formed in silty alluvium or mixed loess and alluvium on stream terraces and in alluvium on bottom lands (see fig. 4, p. 5). After heavy rains, more than 75 percent of the acreage on the bottom lands is subject to flooding. The area of this association is about 21,500 acres, or 6 percent of the county.

Hord soils make up 31 percent of the association; Cass soils, 21 percent; Hobbs soils, 20 percent; and Silty alluvial land and Breaks-Alluvial land complex, the remaining 28 percent.

Hord soils are on stream terraces. They have a surface layer of gray and dark-gray silt loam and a subsoil of dark-gray and gray silt loam. The underlying material is light brownish-gray mixed loess and alluvium or alluvium of silt loam texture.

Cass soils are on bottom lands. They have a surface layer of gray and dark-gray loam or fine sandy loam. The underlying material is grayish-brown and light brownish-gray fine sandy loam that is stratified with silt loam to fine sand. After heavy rains, 85 percent of the acreage of the Cass soils is subject to flooding.

Hobbs soils are on bottom lands. They have a silt loam surface layer, 3 to 4 feet thick, that is grayish brown in the upper part and dark gray or very dark gray in the lower part. The underlying material is light brownish-gray alluvium of silt loam texture. About 70 percent of the acreage of Hobbs soils is subject to flooding.

Miscellaneous land types make up the rest of this association. Silty alluvial land is along the major streams and consists of bottom lands and channels that are subject to frequent and severe flooding. Breaks-Alluvial land complex occurs along streams that drain into the Little Blue River. These areas are not suitable for cultivation.

About one-half the acreage in this association is cultivated. Nearly 40 percent of the cultivated acreage is irrigated. Wheat, grain sorghum, alfalfa, and corn are the main crops. The areas of native grass support stands of tall, mid, and short grasses. Some of the areas that are subject to flooding along the Little Blue River have been reseeded to warm-season native grasses. Most of the wooded areas in the county are in this association. Flooding is the main limitation. The farms are generally a combination of the cash-grain and livestock types. Most farms have access to good gravel roads.

7. Anselmo-Meadin association

Nearly level to gently sloping, deep and shallow, loamy soils; over sand and gravel; on stream terraces

This association consists of well-drained to excessively drained soils on the Platte River terrace. These soils are deep and shallow over sand and gravel. They formed in alluvium. In some areas the alluvium has been reworked by the wind. The area of this association is 3,300 acres, or about 1 percent of the county.

Anselmo soils make up 56 percent of the association; Meadin soils, 20 percent; and minor soils, the remaining 24 percent.

Anselmo soils have a surface layer of light brownish-gray and grayish-brown loam or fine sandy loam. Their subsoil is pale-brown fine sandy loam. The underlying material is light-gray sand.

Meadin soils have a dark-gray sandy loam surface layer. These soils are only 10 to 20 inches thick over mixed coarse sand and gravel.

Minor soils of this association are the Kenesaw, Valentine, and Thurman soils. Kenesaw soils are nearly level and are on stream terraces. Valentine and Thurman soils are in the highest parts of the landscape.

About 75 percent of the acreage in this association is cultivated. Nearly 50 percent of the acreage is irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. The Meadin soils are in native grass and support stands of tall, mid, and short grasses. Conserving moisture and maintaining high fertility are the main concerns of management. Soil blowing is a hazard in the sandy areas that are cultivated. Farms are a combination of the cash-grain and general livestock types. Nearly all farms have access to good gravel roads.

8. Platte-Lex-Alda association

Nearly level to gently sloping, shallow and moderately deep, silty and loamy soils; over sand and gravel; on bottom lands

This association consists of somewhat poorly drained soils on bottom lands of the Platte River. These soils formed in loamy and sandy alluvium and are shallow to moderately deep over sand and gravel. The area of this association is about 1,600 acres, or less than 1 percent of the county.

Platte soils make up 60 percent of the association; Lex and Alda soils, 22 percent; and minor soils, the remaining 18 percent.

Platte soils are shallow to mixed sand and gravel. They have a dark-gray, calcareous loam surface layer that is underlain by mottled, light-gray, calcareous very fine sandy loam. Mixed sand and gravel are at a depth of 10 to 20 inches. A water table fluctuates betwen 2 and 6 feet below the surface.

Lex and Alda soils are moderately deep to mixed sand and gravel and are intermingled. Lex soils have a grayish-brown and gray silt loam surface layer. The under-

lying material is light brownish-gray silt loam that grades to mixed sand and gravel at depths between 20 and 40 inches. Alda soils have a gray and dark-gray loam surface layer. The underlying material is light-gray fine sandy loam. Coarse sand and gravel are between the depths of 20 and 40 inches. Lex and Alda soils are calcareous at or near the surface. The water table is at a depth of 2 to 6 feet.

Cass soils, the only minor soils in this association, are nearly level and are on the highest bottom lands. Riverwash is a land type that occurs along the South Channel of the Platte River.

About 65 percent of this association is cultivated, most of which is irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. In places the high water table causes the soils to warm up slowly in spring. Wetness delays spring planting in some years. Good internal drainage needs to be established for irrigation. The remaining 35 percent of this association is in native grass and is used for grazing or is cut for hay. These areas support stands of mixed native grasses. The main concerns of management in this association are wetness in spring and the low available water capacity of the soils. Farms are a combination of the cash-grain and livestock types. All farms have access to good gravel roads.

9. *Crete-Hastings association*

Nearly level, deep, silty soils on uplands

This association consists of moderately well drained and well drained soils that formed in loess. The area of this association is about 17,200 acres, or 5 percent of the county.

Crete soils make up 65 percent of the association; Hastings soils, 20 percent; and minor soils, the remaining 15 percent (fig. 5).

Crete soils have a surface layer of gray and dark-gray silt loam. Their subsoil is mainly grayish-brown silty clay. The underlying material is light-gray, calcareous loess of silt loam texture.

Hastings soils are dominantly nearly level and on uplands. They have a surface layer of dark grayish-brown silt loam. Their subsoil is mainly grayish-brown and brown heavy silty clay loam. The underlying material is very pale brown, calcareous loess of silt loam texture.

The minor soils of this association are the Holder, Fillmore, Scott, and Hobbs soils. Holder soils are moderately sloping to strongly sloping and are on the side slopes of upland drainageways. Fillmore and Scott soils occur in depressions of the uplands. Hobbs soils are on the bottoms of draws in the uplands and are occasionally flooded.

Most of the acreage in this association is cultivated.

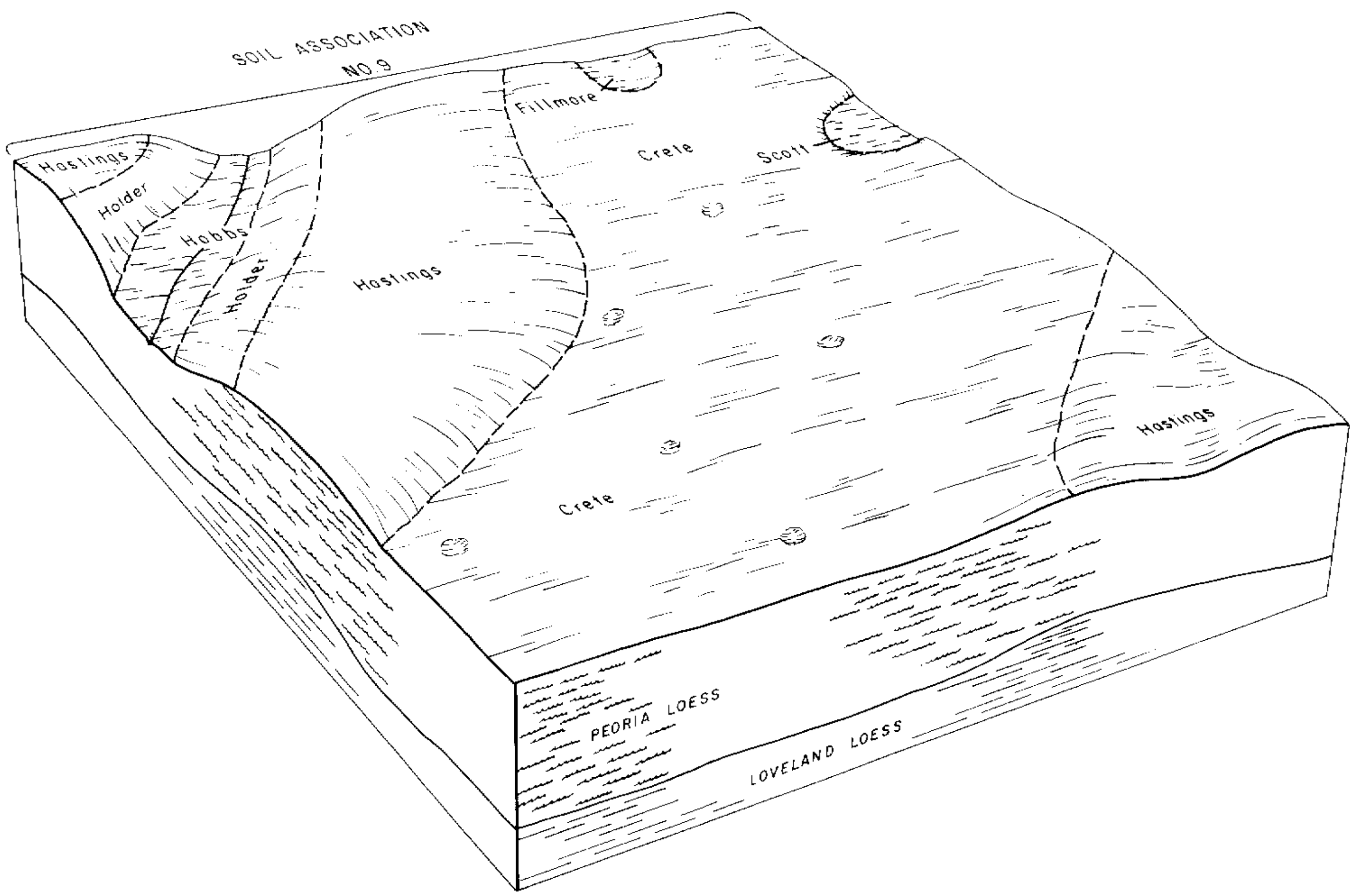


Figure 5.—**Typical pattern of soils and underlying materials in association 9.**

About 40 percent of the association is irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. The areas of native grass support stands of mid and short grasses. The main concerns of management in this association are maintaining high fertility and conserving soil moisture. Water erosion is a hazard where slopes are moderate to strong. Farms are of the cash-grain type, but farmers use some of the grain to fatten livestock. Nearly all farms have access to good gravel or hard-surface roads.

Descriptions of the Soils

This section describes the soil series and mapping units in Adams County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or the differences are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Riverwash, for example, does not belong to a soil series; nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, and windbreak suitability group in which the mapping unit has been placed. The page for the description of each capability unit, range site, and windbreak suitability group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[1]

The names of some soils described in this publication are unlike those appearing in recently published surveys of adjacent counties. This is because of change in concepts of soil series in the application of the soil classification system. For some series, the profile selected as representative has one or more features outside the defined range of characteristics. In these instances, a reference is made to explain how the soil differs. Unless otherwise stated, the profiles have characteristics that are within the defined range of the series.

Some soil boundaries and soil names may not match those of adjoining areas in adjacent counties. This is because of changes in slope groupings, combinations of mapping units, or correlation procedures that were used in classifying and mapping the soils.

Alda Series

The Alda series consists of moderately deep, somewhat poorly drained soils that formed in recent alluvium and are 20 to 40 inches deep over coarse sand and gravel. These are nearly level soils on bottom lands of the Platte River valley. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile the surface layer is loam about 13 inches thick. The upper 8 inches has been disturbed in tillage and is gray; the lower 5 inches is dark gray. Lime is at the surface in most places. Below the surface layer is a transitional layer of light-gray fine sandy loam about 6 inches thick. It is soft when dry and very friable when moist. It has reddish-brown mottles. The underlying material, to a depth of about 26 inches, is light-gray loamy sand that has reddish-brown mottles. Below this is white coarse sand and gravel.

Alda soils have moderately rapid permeability in the upper part of the profile and very rapid permeability in the underlying coarse sand and gravel. The available water capacity is low. Natural fertility is medium to low, and organic-matter content is moderate.

Most areas of these soils are cultivated. Wetness limits crop growth in some seasons, but the water table provides subirrigation in drier seasons. These soils are droughty in dry years. They respond well to irrigation. If they are leveled for gravity irrigation, the coarse-textured material is exposed in places. Areas in native grass are used for grazing or hay. These soils are suited to growing trees for windbreaks and to use by wildlife.

In this county Alda soils are mapped only in an undifferentiated group with Lex soils.

Representative profile of Alda loam in an area of Lex and Alda soils, 0.2 mile south and 25 feet east of the northwest corner of sec. 7, T. 8 N., R. 12 W.:

Ap—0 to 8 inches, gray (10YR 5/1) loam, very dark gray 10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

A12—8 to 13 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to weak, medium, granular; soft, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.

AC—13 to 19 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; few, fine, prominent, reddish-brown (5YR 5/4) mottles; weak, coarse, subangular blocky structure parting to single grained; soft, very friable; slight effervescence; a few pebbles; moderately alkaline; gradual, smooth boundary.

C1—19 to 26 inches, light-gray (10YR 7/2 loamy sand, light brownish gray (10YR 6/2) moist; common, fine, distinct, reddish-brown (5YR 5/4) mottles; single grained; loose; a few pebbles; mildly alkaline; clear, smooth boundary.

[1] Italic numbers in parentheses refer to Literature Cited, p. 77.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	589	0.2
Anselmo fine sandy loam, terrace, 1 to 3 percent slopes	499	.1
Anselmo loam, terrace, 0 to 1 percent slopes	1,042	.3
Breaks-Alluvial land complex	1,234	.3
Butler silt loam	3,988	1.1
Cass fine sandy loam	898	.3
Cass loam	455	.1
Cass loam, occasionally flooded	3,333	.9
Coly silt loam, 7 to 11 percent slopes	923	.3
Coly silt loam, 11 to 31 percent slopes	9,295	2.6
Crete silt loam	15,990	4.4
Fillmore silt loam	3,211	.9
Geary silt loam, 3 to 7 percent slopes	441	.1
Geary silt loam, 7 to 11 percent slopes	498	.1
Geary silt loam, 11 to 31 percent slopes	6,191	1.7
Geary silty clay loam, 3 to 7 percent slopes, eroded	1,374	.4
Geary silty clay loam, 7 to 11 percent slopes, eroded	2,282	.6
Hall silt loam	6,431	1.8
Hastings silt loam, 0 to 1 percent slopes	91,237	25.3
Hastings silt loam, 1 to 3 percent slopes	8,932	2.5
Hastings silt loam, thin solum variant	3,110	.9
Hersh fine sandy loam, 3 to 7 percent slopes	1,377	.4
Hersh-Kenesaw complex, undulating	410	.1
Hobbs silt loam	2,450	.7
Hobbs silt loam, occasionally flooded	6,700	1.9
Holder silt loam, 0 to 1 percent slopes	18,803	5.2
Holder silt loam, 1 to 3 percent slopes	23,115	6.4
Holder silt loam, 3 to 7 percent slopes	4,596	1.3
Holder silt loam, 7 to 11 percent slopes	5,530	1.5
Holder silt loam, 3 to 7 percent slopes, eroded	13,785	3.8
Holder silty clay loam, 3 to 7 percent slopes, severely eroded	9,551	2.6
Holder silty clay loam, 7 to 11 percent slopes, severely eroded	15,242	4.2
Hord silt loam, 0 to 1 percent slopes	10,850	3.0
Hord silt loam, terrace, 0 to 1 percent slopes	5,510	1.5
Hord silt loam, terrace, 1 to 3 percent slopes	1,076	.3
Inavale loamy fine sand	943	.3
Inavale fine sandy loam	568	.2
Kenesaw silt loam, 0 to 1 percent slopes	20,943	5.8
Kenesaw silt loam, 1 to 3 percent slopes	22,452	6.3
Kenesaw silt loam, 3 to 7 percent slopes	7,280	2.0
Kenesaw silt loam, terrace, 0 to 1 percent slopes	2,059	.6
Lex and Alda soils	345	.1
Marsh	248	.1
Meadin sandy loam	630	.2
Platte loam	953	.6
Riverwash	132	[1]
Rough broken land, loess	491	.1
Rusco silt loam	853	.2
Scott silt loam	903	.2
Silty alluvial land	6,113	1.7
Spoil banks	143	[1]
Thurman-Valentine loamy fine sands, undulating	1,726	.5
Valentine loamy fine sand, rolling	10,514	2.9
Streams and ponds	1,351	.4
Gravel pits and quarries	85	[1]
Total	359,680	100.0

[1] Less than 0.05 percent.

IIC2—26 to 60 inches, white (10YR 8/2) coarse sand and gravel, light brownish gray (10YR 6/2) moist; single grained; mildly alkaline.

The A horizon is 10 to 18 inches thick. It ranges from fine sandy loam to silt loam, but loam is most common. It is dark gray to grayish brown. The AC horizon is fine sandy loam or sandy loam 4 to 8 inches thick. The AC and C1 horizons range from gray to very pale brown. The C1 horizon is stratified with fine sandy loam to sand. Coarse sand and gravel are at depths between 20 and 40 inches.

Alda soils are near Platte and Lex soils. They are deeper over coarse sand and gravel than Platte soils. Alda soils have a coarser textured AC horizon than Lex soils, and they typically have a coarser textured C1 horizon than those soils.

Anselmo Series

The Anselmo series consists of deep, well-drained soils that formed in loamy and sandy alluvium or in alluvium that has been reworked by wind. These soils mainly occupy stream terraces along Sand and Cottonwood Creeks and in the valley along the Platte River. Slopes range from 0 to 3 percent. Some areas are hummocky.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. The upper part is light brownish gray, and the lower part is grayish brown. The subsoil is pale-brown fine sandy loam about 20 inches thick. It is soft when dry and very friable when moist. The underlying material is light-gray sand that is stratified with fine sandy loam and loamy fine sand. Lime is at a depth of about 30 inches.

Anselmo soils have moderately rapid permeability. Organic-matter content is moderately low, and natural fertility is medium. Available water capacity is moderate.

Most areas of the Anselmo soils are cultivated. The soils tend to be somewhat droughty under dryland management, but they respond well to irrigation. Areas in native grass are used mostly for grazing. These soils are well suited to trees in windbreaks and to use by wildlife.

Representative profile of Anselmo fine sandy loam, terrace, 0 to 1 percent slopes, 0.2 mile south and 400 feet west of the northeast corner of sec. 7, T. 7 N., R. 12 W.:

Ap—0 to 5 inches, light brownish-gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—5 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, granular; soft, very friable; neutral; abrupt, smooth boundary.

B—10 to 30 inches, pale-brown (10YR 6/3) fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure parting to single grained; soft, very friable; mildly alkaline; abrupt, smooth boundary.

IIC—30 to 60 inches, light-gray (10YR 7/2) sand, stratified with fine sandy loam and loamy fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; slight effervescence; moderately alkaline.

The A horizon is fine sandy loam to silt loam 8 to 14 inches thick. Its color ranges from gray to grayish brown. The B horizon is grayish-brown to pale-brown sandy loam or fine sandy loam 12 to 20 inches thick. The IIC horizon is light-gray to pale-brown fine sandy loam to sand and is

commonly stratified with silt loam to sand. In some areas pebbles are scattered throughout the profile.

Anselmo soils are near Hersh and Meadin soils. They have a thicker, darker A horizon and a better developed profile than Hersh soils. In contrast to Anselma soils, Meadin soils are underlain by coarse sand and gravel at a depth of 10 to 20 inches.

Anselmo fine sandy loam, terrace, 0 to 1 percent slopes (2An).—This soil is on stream terraces. It formed in loamy and sandy alluvium. It has the profile described as representative for the series.

Included with this soil in mapping were some areas of soils that have a surface layer of loamy sand. Also included were some small areas of soils that have silt loam material below a depth of 24 inches.

Surface runoff is slow. Soil blowing can be a hazard if the surface is left unprotected. Conserving moisture is a concern under dryland management.

Most of the acreage of this soil is cultivated. This soil is well suited to irrigation. Leveled areas are low in organic-matter content and natural fertility. If deep cuts are made, coarse-textured material is exposed in places. Wheat, grain sorghum, and alfalfa are the principal dryland crops. Corn and grain sorghum are irrigated. Capability units IIe–3, dryland, and IIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Anselmo fine sandy loam, terrace, 1 to 3 percent slopes (2AnA).—This soil has low, hummocky to smooth slopes and is on stream terraces. It formed in loamy and sandy alluvium that has been reworked by the wind. It has a profile similar to the one described as representative for the series, except the surface layer is not so thick.

Included with this soil in mapping were areas of eroded soils that have a loamy fine sand surface layer 4 to 6 inches thick. These soils are on hummocks. In some places the swales between the hummocks have collected the material eroded from the hummocks, and the soils in these areas have a fine sandy surface layer that is more than 14 inches thick. Also included were a few small areas of Hersh soils.

Surface runoff is slow. Soil blowing is a hazard in areas that are not protected by plant cover. Conserving moisture is a concern under dryland management.

Most of the acreage of this soil is cultivated. This soil is suited to irrigation. Land leveling is needed to smooth the slopes for gravity irrigation. In leveled areas the soils generally are low in fertility and organic-matter content. Wheat, grain sorghum, and alfalfa are the principal dryland crops. Corn and grain sorghum are irrigated. Capability units IIIe–31, dryland, and IIe–31, irrigated; Sandy range site; Sandy windbreak suitability group.

Anselmo loam, terrace, 0 to 1 percent slopes (2Ap).—This soil is on stream terraces. It formed in alluvium. It has a profile similar to the one described as representative for the series, except that the surface layer is loam.

Included with this soil in mapping were areas where free lime is at a depth of 14 to 30 inches. Also included were some areas of soils that have silty to clayey layers at a depth below 3 feet. A few areas of soils that have a silt loam surface layer were also included.

Surface runoff is slow. Conserving moisture is a concern where this soil is dryfarmed. Workability is good.

This soil is cultivated, and most of it is irrigated. It is well suited to irrigation and responds well to fertilizer. Where leveling for irrigation is needed, deep cuts should be avoided if possible to prevent exposing sandy material. Corn and grain sorghum are the main irrigated crops, and wheat, grain sorghum, and alfalfa are the main dryland crops. Capability units IIc–1, dryland, and I–1, irrigated; Sandy range site; Silty to Clayey windbreak suitability group.

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (0 to 45 percent slopes) (By) lies along some of the major drainageways and creeks in the county (fig. 6). Breaks make up about 50 to 60 percent of the area, consist of immature soils that formed in loess or alluvium, and have slopes of 15 to 45 percent. Alluvial land, which makes up the remaining 40 to 50 percent, consists of light- and dark-colored, stratified, loamy sediment that has accumulated on the narrow, nearly level bottom lands. The bottom lands are subject to frequent and severe flooding.

This complex supports a thin, scattered growth of trees and woody shrubs. The Breaks part supports mostly mid and short grasses. The Alluvial land part generally supports a mixture of grasses and annual weeds.

This complex is used mostly for grazing. It is not suitable for cultivation. It is well suited as a source of food and habitat for wildlife. Capability unit VIe–1, dryland; Breaks part is in Silty range site and Undesirable windbreak suitability group; Alluvial land part is in Silty Overflow range site and Undesirable windbreak suitability group.

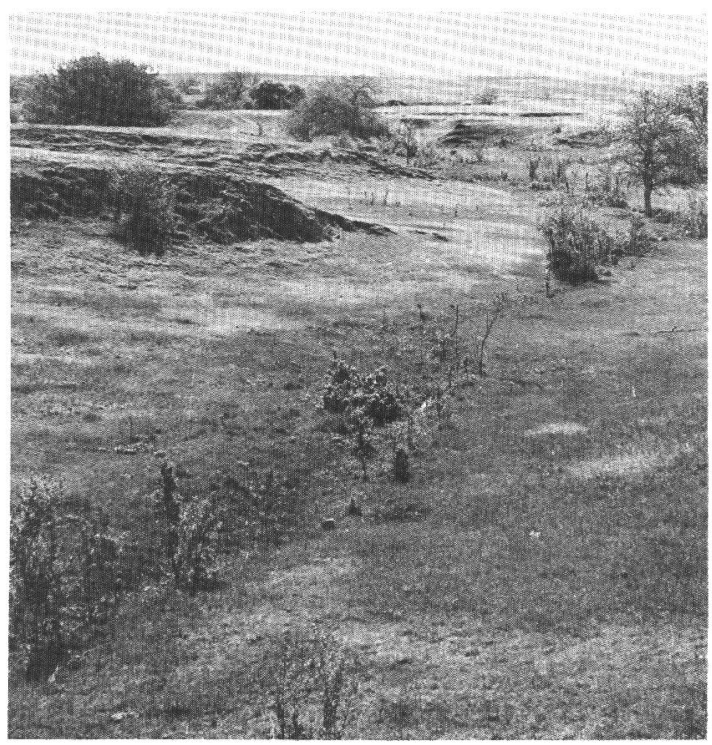


***Figure 6.*—Typical area of Breaks-Alluvial land complex. Breaks are on the steep side slopes. Alluvial land is on the bottom of the draw.**

Butler Series

The Butler series consists of deep, somewhat poorly drained soils that have a claypan subsoil. These soils are nearly level and are on uplands at the heads of drainageways or in slight depressions. They formed in calcareous loess.

In a representative profile the surface layer is dark-gray silt loam about 13 inches thick. The subsurface layer is gray silt loam about 2 inches thick. The subsoil extends to a depth of about 44 inches. It is dark-gray silty clay in the upper part, dark grayish-brown silty clay in the middle part, and grayish-brown silty clay loam in the lower part. A few dark-brown concretions are scattered throughout the upper and middle parts of the subsoil. The subsoil is very hard when dry and very firm when moist. A few accumulations of lime are in the lower part of the subsoil. The underlying material is light-gray, calcareous silt loam and is stained with iron.

Butler soils have a high available water capacity. Permeability is slow. Organic-matter content is moderate, and natural fertility is medium. Lack of surface drainage is a concern where these soils are adjacent to the more poorly drained Fillmore and Scott soils.

Most areas of Butler soils are cultivated. These soils are suited to irrigation if they are adequately drained. Under dryland management they are somewhat droughty. Areas in native grass are suited to grazing or hay. These soils can also be used for trees and as a source of food for wildlife.

Representative profile of Butler silt loam, in a cultivated field, 0.25 mile north and 100 feet east of the southwest corner of sec. 5, T. 8 N., R. 10 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 13 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate, fine, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

A2—13 to 15 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak, medium, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

B21t—15 to 28 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to strong, medium, angular blocky; very hard, very firm; a few dark-brown concretions; neutral; clear, smooth boundary.

B22t—28 to 36 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; very hard, very firm; few dark-brown concretions; mildly alkaline; gradual, wavy boundary.

B3—36 to 44 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure parting to moderate, medium, subangular blocky; hard, firm; few soft lime accumulations; mildly alkaline; gradual, wavy boundary.

C—44 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak, coarse, subangular blocky structure parting to massive; soft, very friable; many, coarse, prominent iron stains; strong effervescence; moderately alkaline.

The solum ranges from 34 to 52 inches in thickness. The Ap or A1 horizon ranges from 12 to 15 inches in thickness. Its color ranges from dark gray to grayish brown. The A2 horizon is less than 3 inches thick and, in places, is visible only when dry. The B2t horizon ranges from 12 to 26 inches in thickness. It is dark gray to grayish brown. The C horizon ranges from light brownish gray to light gray and has reddish-brown or yellowish-brown iron stains. Depth to lime ranges from 30 to 54 inches.

Butler soils are near Fillmore and Crete soils. They have a thinner A2 horizon and are better drained than Fillmore soils. Butler soils have an A2 horizon, which is lacking in Crete soils. Also, they have a darker colored B2t horizon and are more poorly drained than Crete soils.

Butler silt loam (0 to 1 percent slopes) (Bu).—This soil is on flat uplands or in slight depressions.

Included with this soil in mapping were areas that have a surface layer 15 to 24 inches thick. Also included were small areas of Fillmore and Crete soils.

Because this soil has a slowly permeable subsoil, it is droughty under dryland management, but it responds well to irrigation. Runoff from adjacent areas causes ponding in some places. Surface runoff is slow. Surface drainage needs to be established before some areas of this soil can be irrigated.

This soil is used mostly for cultivated crops. Wheat, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are irrigated. Areas in native grass are used mostly for grazing. Capability units IIw–2, dryland, and IIs–21, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Cass Series

The Cass series consists of deep, well-drained soils that formed in recent alluvium. These soils are nearly level and are on bottom lands along Sand and Cottonwood Creeks, the Little Blue River, and the Platte River. They are subject to occasional flooding, except where they are on some of the higher bottom lands. The water table is 6 to 15 feet beneath the surface.

In a representative profile the surface layer is loam about 10 inches thick. The upper 6 inches has been disturbed by tillage and is gray; the lower part is dark gray. Below the surface layer is a transitional layer of grayish-brown, very friable fine sandy loam 5 inches thick. The underlying material is fine sandy loam that is stratified with lenses and layers that range from silt loam to loamy sand. Colors are grayish brown to light gray. Lime is at a depth of about 38 inches.

Cass soils have moderately rapid permeability. Available water capacity is moderate. Natural fertility is medium to low, and organic-matter content is moderately low.

About one-half of the acreage of these soils is cultivated, and much of this is irrigated. Areas in native grass are best suited to grazing or hay. A few areas along the Little Blue River are covered with trees. These soils are well suited to trees in windbreaks and to use by wildlife.

Representative profile of Cass loam, occasionally flooded, 0.35 mile north and 70 feet east of the southwest corner of sec. 10, T. 5 N., R. 11 W.:

Ap—0 to 6 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—6 to 10 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak, medium, granular structure; soft, very friable; neutral; clear, smooth boundary.

AC—10 to 15 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak,

coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft, very friable; neutral; gradual, smooth boundary.

C1—15 to 30 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft, very friable; neutral; gradual, smooth boundary.

C2—30 to 38 inches, light-gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; weak, coarse, subangular blocky structure parting to single grained; loose; mildly alkaline; abrupt, smooth boundary.

IIC3—38 to 47 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

IIIC4—47 to 60 inches, light brownish-gray (10YR 6/2) fine sandy loam stratified with loam and loamy sand, grayish brown (10YR 5/2) moist; weak, thin, platy structure; soft, very friable; slight effervescence; moderately alkaline; abrupt, smooth boundary.

The A horizon ranges from fine sandy loam to loam. Its colors range from dark gray to grayish brown. This horizon is 9 to 18 inches thick. The AC and C horizons are fine sandy loam that is commonly stratified with silt loam to fine sand. Their colors range from grayish brown to very pale brown. Free lime and iron stains are common at a depth of 30 to 60 inches.

In mapping unit Cs, the surface layer of Cass fine sandy loam is thinner than is recognized in the range defined for the Cass series, but this difference does not alter the usefulness or behavior of the soils.

Cass soils are near Hobbs and Inavale soils. They have a thinner A horizon and are coarser textured in the C horizon than Hobbs soils. Cass soils have a thicker A horizon than Inavale soils and are not so coarse textured in the C horizon as those soils.

Cass loam (0 to 1 percent slopes) (Cm).—This soil is on high bottom lands that are generally not subject to flooding.

Included with this soil in mapping were areas of soils that have a very fine sandy loam or silt loam surface layer. Also included were a few areas of soils that have a fine sandy loam surface layer only 5 to 8 inches thick, some areas in which the underlying material is silt loam, and some areas that are calcareous at depths between 12 and 30 inches.

This soil is medium in natural fertility. Surface runoff is slow. The soil is easily worked. Erosion is only a slight hazard.

Nearly all of this soil is cultivated, and most of it is irrigated. Corn and grain sorghum are the main irrigated crops. Generally, little land shaping is needed for gravity irrigation; however, deep cuts should be avoided to prevent exposing sandy material. This soil responds well to irrigation. Capability units I–1, dryland, and I–2, irrigated; Sandy Lowland range site; Silty to Clayey windbreak suitability group.

Cass loam, occasionally flooded (0 to 1 percent slopes) (2Cm).—This soil is on bottom lands that are subject to occasional flooding. It occurs mainly along Cottonwood Creek and the Little Blue River. This soil has the profile described as representative for the Cass series.

Included with this soil in mapping were a few areas where the surface layer is silty clay loam or fine sandy loam, small areas that have a water table within 2 feet of the surface, and small areas of Hobbs soils. Areas that have a high water table are along the Little Blue River.

This soil is flooded once or twice a year in about 1 year in 3. Floods follow heavy rains but are of short duration. The floods seldom cause complete loss of crops, but they sometimes delay tillage or necessitate reseeding of newly planted crops. Normal surface runoff is slow. Areas that have been leveled for irrigation can be damaged by floodwaters and commonly need to be repaired or leveled again before they can be irrigated.

Most of the acreage of this soil is used for range, and some of it is covered with trees. Some areas, however, are cultivated, mainly to grain sorghum, corn, and wheat. Wheat is not grown extensively, because of the hazard of crop damage or loss by floods in spring. Only a small acreage of this soil is presently irrigated. This soil is easily worked. Capability units IIw–3, dryland, and IIw–3, irrigated; Sandy Lowland range site; Moderately Wet windbreak suitability group.

Cass fine sandy loam (0 to 1 percent slopes) (Cs).—This soil is on high bottom lands. It has a profile similar to the one described as representative for the series, except that the surface layer is fine sandy loam 6 to 8 inches thick.

Included with this soil in mapping were a few areas of soils that are lighter colored than this Cass soil and some areas of soils that have a surface layer of loamy fine sand.

Surface runoff is slow. Soil blowing is a hazard in cultivated areas. Some of the lower areas of this soil are flooded following heavy rains. Where crops are flooded, they can be damaged by the force of the floodwater or by sediment deposited by the floodwater. This soil is somewhat droughty and is low in natural fertility. It is easily worked and responds well to irrigation and fertilizer.

More than half of the acreage of this soil is in native grass and is used for grazing. The rest is cultivated, but only a small part is irrigated. Grain sorghum and wheat are the main dryland crops. Corn is irrigated in some places. Capability units IIe–3, dryland, and IIe–3, irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Coly Series

The Coly series consists of deep, well-drained to somewhat excessively drained soils that formed in calcareous loess. These soils are strongly sloping to steep and are along upland drainageways throughout the county.

In a representative profile the surface layer is dark grayish-brown silt loam about 5 inches thick. Next is a transitional layer of pale-brown, very friable silt loam about 3 inches thick. The underlying material is very pale brown silt loam. Lime is at a depth of 8 inches.

Coly soils have moderate permeability. Organic-matter content is low, and natural fertility is high. Available water capacity is high.

These soils are mostly in native grass and are used for grazing. A few areas are cut for hay. These soils are well suited to trees and to use by wildlife.

Representative profile of Coly silt loam, 11 to 31 percent slopes, 0.3 mile west and 100 feet north of the southeast corner of sec. 11, T. 6 N., R. 11 W.:

A—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

AC—5 to 8 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, fine, subangular blocky

structure; soft, very friable; mildly alkaline; abrupt, wavy boundary.

C—8 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak, coarse, prismatic structure parting to massive, soft, very friable; reddish-brown stains and accumulations of soft lime; strong effervescence; moderately alkaline.

The A horizon ranges from 4 to 6 inches in thickness. Colors range from dark grayish brown to pale brown. The AC horizon is grayish brown to pale brown. It ranges from 3 to 5 inches in thickness. The C horizon is light brownish-gray to very pale brown silt loam. Depth to lime ranges from 5 to 10 inches, but lime is at the surface in some places.

Coly soils are near Holder and Kenesaw soils. They have a thinner A horizon than the Holder soils and lack the B horizon of those soils. Coly soils have a thinner A horizon and lime nearer the surface than the Kenesaw soils.

Coly silt loam, 7 to 11 percent slopes (CbC).—This well-drained soil is on the sides of upland drainageways. Where this soil is in native grass, it has a profile similar to one described as representative for the series. In cultivated areas, the surface layer is light brownish gray to pale brown, and in some places it is calcareous.

Included were a few areas of soils in which the profile is stratified with fine sandy loam and loamy sand material and is not calcareous.

Surface runoff is medium. Water erosion can be a hazard where this soil is cultivated. Many cultivated areas have many small gullies.

About 70 percent of the acreage of this soil is cultivated. Wheat, grain sorghum, and alfalfa are the main crops. Some areas have been seeded to warm-season native grasses. Capability unit IVe–8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Coly silt loam, 11 to 31 percent slopes (CbD).—This somewhat excessively drained soil is on the sides of upland drainageways and on hills and bluffs throughout the county. It has the profile described as representative for the series.

Included with this soil in mapping were some small areas of Geary soils and a few small areas of Rough broken land, loess. As much as 30 percent of some areas mapped consists of Hobbs soils.

Surface runoff is rapid. The steep slopes and the severe hazard of erosion make this soil unsuitable for cultivation. Slopes are irregular, and catsteps and soil slips are common.

This soil is in native grass and is used mostly for grazing (fig. 7). In some areas the grass is cut for hay. Some slopes of less than 15 percent have been cultivated, but most of these have been seeded to grass because the steep slopes make cultivation difficult. Capability unit VIe–9, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Figure 7.—Area of Coly silt loam, 11 to 31 percent slopes, in native range.

Crete Series

The Crete series consists of deep, moderately well drained soils that have a slowly permeable claypan subsoil. These are nearly level soils that formed in calcareous loess on uplands.

In a representative profile the surface layer is silt loam about 11 inches thick. The upper 5 inches has been disturbed by tillage and is gray; the lower part is dark gray. The subsoil extends to a depth of about 26 inches. It is grayish-brown silty clay in the upper part and pale-brown silty clay loam in the lower part. It is very hard when dry and very firm when moist. The underlying material is light-gray silt loam. Lime is at a depth of about 26 inches.

Crete soils have slow permeability. They have moderate organic-matter content and medium natural fertility. Available water capacity is high. These soils absorb water slowly because of the claypan subsoil, and they tend to be droughty if dryfarmed. They are easy to work.

Most areas of these soils are cultivated. The soils are well suited to irrigation. Areas in native grass are used for grazing. These soils are also well suited to trees in windbreaks, and the areas can be used as a source of food for wildlife.

Representative profile of Crete silt loam, 0.25 mile east and 200 feet south of the northwest corner of sec. 13, T. 6 N., R. 9 W.:

Ap—0 to 5 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—5 to 11 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate, medium and fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—11 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.

B2t—13 to 22 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate, coarse, subangular blocky structure parting to strong, medium and fine, angular blocky; very hard, very firm; neutral; clear, smooth boundary.

B3—22 to 26 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate, coarse, subangular blocky structure parting to moderate, medium, subangular blocky; hard, friable; mildly alkaline; clear, smooth boundary.

C—26 to 60 inches, light-gray (2.5Y 7/2) silt loam, pale brown (10YR 6/3) moist; weak, coarse, subangular blocky structure parting to massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 24 to 36 inches in thickness. The A horizon ranges from 9 to 12 inches in thickness. Its color ranges from dark grayish brown to gray. The B horizon is 12 to 24 inches thick. Color in this horizon ranges from dark brown to pale brown. The B2t horizon is silty clay 8 to 12 inches thick and averages 45 to 52 percent clay. The C horizon is light gray to pale yellow. Depth to lime ranges from 24 to 40 inches.

Crete soils in Adams County have a lighter brown B horizon, have a thinner solum, and are less acid in the upper part of the profile than is recognized in the range defined for the series. These differences do not alter the usefulness and behavior of the soils.

Crete soils are near Hastings and Butler soils. They have a more clayey B2t horizon than Hastings soils. They are better drained than Butler soils.

Crete silt loam (0 to 1 percent slopes) (Ce).—This soil is on uplands. Included in mapping were a few small areas of Fillmore soils, and as much as 15 percent of some areas mapped consists of Hastings and Butler soils.

Surface runoff is slow. The slowly permeable subsoil restricts the intake of water. This soil is easily worked, and it has good tilth.

This soil is used mostly for cultivated crops. Wheat, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are irrigated. About 10 percent of the acreage of this soil is in native grass and is used for grazing. Available zinc is low in areas where deep cuts are made. Capability units IIs–2, dryland, and IIs–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Fillmore Series

The Fillmore series consists of deep, poorly drained soils that have a claypan subsoil. These soils formed in loess. They are nearly level and are in shallow upland depressions. They receive runoff from the surrounding soils, and water ponds on the surface for short periods after heavy rains.

In a representative profile the surface layer is silt loam about 9 inches thick. The upper 6 inches has been disturbed by tillage and is gray; the lower part is dark gray. The subsurface layer is gray to light-gray silt loam about 6 inches thick. It grades abruptly to claypan subsoil. The subsoil extends to a depth of 56 inches. It is dark-gray to gray, very firm silty clay in the upper part and grayish-brown silty clay loam in the lower part. The underlying material is light brownish-gray silt loam.

Permeability is slow. Most of the depressions lack natural drainage outlets, and as a result, runoff from surrounding areas pond on these soils until the water evaporates or is absorbed by the soil. Organic-matter content is moderate, and natural fertility is medium. Available water capacity is high. These soils absorb water very slowly and release it slowly to plants.

Fillmore soils are used mostly for cultivated crops. They are suited to irrigation if they are drained, leveled, and fertilized. Without artificial drainage, these soils are not well suited to wheat, and planting of row crops may be delayed by wetness in some years. The amount of moisture received and the amount of ponded runoff greatly affect the use of these soils for cultivated crops. Areas in native grass are used mostly for grazing. Fillmore soils are suited to trees in windbreaks if proper surface drainage is established. They can be used as a source of food for wildlife.

Representative profile of Fillmore silt loam, 0.12 mile east and 300 feet north of the southwest corner of sec. 29, T. 8 N., R. 11 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 9 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, medium, platy structure parting to weak, fine, granular; soft, very friable; slightly acid; abrupt, smooth boundary.

A21—9 to 12 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, thin, platy structure; soft, very friable; slightly acid; clear, smooth boundary.

A22—12 to 15 inches, light-gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak, thin, platy structure; soft, very friable; neutral; abrupt, smooth boundary.

B21t—15 to 29 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate, coarse, prismatic structure parting to strong, medium and fine, angular blocky; very hard, very firm; dark-brown concretions; neutral; clear, smooth boundary.

B22t—29 to 42 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; very hard, very firm; dark-brown concretions; neutral; clear, smooth boundary.

B3—42 to 56 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; gradual, smooth boundary.

C—56 to 60 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; neutral.

The solum ranges from 36 to 60 inches in thickness. The A1 horizon ranges from 6 to 12 inches in thickness, and the A2 horizon from 4 to 8 inches. The B2t horizon ranges from 20 to 30 inches in thickness. It is clay or silty clay that contains 45 to 55 percent clay. The C horizon ranges from light brownish gray to light gray in hues of 10YR and 2.5Y. Depth to free lime is mostly more than 60 inches but ranges from 38 to 72 inches or more.

Fillmore soils are near Butler, Crete, and Scott soils. They are more poorly drained than Butler and Crete soils. They have a thicker A2 horizon than Scott soils and are not so frequently flooded as those soils.

Fillmore silt loam (0 to 1 percent slopes) (Fm).—This soil is in upland depressions. It occurs mostly in oval areas 5 to 200 acres in size. Included in mapping were some small areas of Butler and Scott soils.

Surface runoff is very slow. The major concern is runoff from adjacent areas that ponds on this soil for a period of several days to 2 or 3 weeks following heavy rains (fig. 8). Damage to crops can be expected in most years, and total loss of crops can be expected 1 year in 5 unless good surface drainage is established.

Wheat and grain sorghum are the main dryland crops. The hazard of flooding in spring can cause damage to wheat or delay the planting of row crops. Some areas can be irrigated if they are drained and leveled. Corn and grain sorghum are the main irrigated crops. Where this soil is in native grass, it is used for grazing or hay. Capability units IIIw–2, dryland, and IIs–22, irrigated; Clayey Overflow range site; Moderately Wet windbreak suitability group.

Figure 8.—Typical area of Fillmore silt loam. Tillage is delayed because this soil is slow to dry out. Water stands in shallow depressions until it either is absorbed or evaporates.

Geary Series

The Geary series consists of deep, well-drained to somewhat excessively drained soils on uplands, mostly along the Little Blue River and its tributaries. These soils formed in moderately fine textured loess. Slopes range from 3 to 31 percent.

In a representative profile the surface layer is dark grayish-brown silt loam about 10 inches thick. The subsoil extends to a depth of about 43 inches. It is brown, firm silty clay loam in the upper part and light-brown, firm, calcareous silty clay loam in the lower part. The underlying material is light-brown silty clay loam. Free lime is at a depth of 34 inches.

Geary soils have moderately slow permeability. Available water capacity is high. Organic-matter content is moderate to low, and natural fertility is medium to low.

About one-third of the acreage of these soils is cultivated. Areas in native grass are used mostly for grazing. These soils are well suited to trees. They can be used as a source of food and habitat for wildlife.

Representative profile of Geary silt loam, 3 to 7 percent slopes, 0.3 mile north and 100 feet east of the southwest corner of sec. 8, T. 5 N., R. 9 W.:

A—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; slightly hard, very friable; neutral; clear, smooth boundary.

B1—10 to 14 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B21t—14 to 26 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate, coarse, angular blocky structure parting to moderate, fine, angular blocky; hard, firm; neutral; gradual, smooth boundary.

B22t—26 to 34 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; hard, firm; mildly alkaline; clear, smooth boundary.

B3—34 to 43 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak, coarse, prismatic structure parting to weak, medium, angular blocky; slightly hard, friable; strong effervescence; moderately alkaline; clear, smooth boundary.

C—43 to 60 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak, coarse, prismatic structure parting to massive; slightly hard, friable; violent effervescence; moderately alkaline.

The solum ranges from 26 to 45 inches in thickness. The A horizon ranges from dark grayish brown to grayish brown in a hue of 10YR. It ranges from 7 to 12 inches in thickness and from silt to silty clay loam in texture. The B horizon is dark brown to light brown in hues of 7.5YR and 10YR. Its structure is angular or subangular blocky. The B2t horizon is silty clay loam having a clay content of 27 to 35 percent. The C horizon is light brown to pink in a hue of 7.5YR. Texture of this horizon ranges from silty clay loam to loam. Exposures of sand and gravel are common on the moderately steep and steep slopes. Depth to lime mostly ranges from 26 to 40 inches.

Geary soils in this county have lime higher in the profile than is defined in the range for the series. The eroded Geary soils have an A horizon of grayish-brown to brown silty clay loam that is less than 7 inches thick. The Geary silty clay loams have a surface layer that is thinner and lighter in color than is defined in the range for the Geary series, but this difference does not alter their usefulness or behavior.

Geary soils are near Holder and Coly soils. They formed in loess of a browner color than either Holder or Coly soils. Geary soils have a B horizon, which Coly soils lack, and they have lime that is leached to a greater depth than that in the Coly soils.

Geary silt loam, 3 to 7 percent slopes (GsB).—This well-drained soil is on hillsides and the sides of drainageways on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were some areas of soils in which the subsoil is heavy silty clay loam. Also included were small areas of Holder and Hobbs soils.

Runoff is medium. Erosion is a hazard in cultivated areas. Natural fertility is medium, and organic-matter content is moderate.

Most areas of this soil are in native grass and are used for grazing. A few areas are used for hay. Where this soil is cultivated, wheat and grain sorghum are the main crops. Capability units IIIe-1, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Geary silt loam, 7 to 11 percent slopes (GsC).—This well-drained soil is on the sides of drainageways on uplands. It has a profile similar to the one described as representative for the series, except that the subsoil is not so thick. Sand and gravel exposures are common.

Included with this soil in mapping were areas where the subsoil is 14 to 20 inches thick and some areas where the depth to lime ranges from 18 to 26 inches. Also included were small areas of Holder soils. As much as 15 percent of some mapped areas consists of Hobbs soils on the bottoms of drainageways.

This soil is medium in natural fertility. Organic-matter content is moderate. Runoff is medium to rapid. Erosion is a severe hazard if this soil is cultivated.

Nearly all of the acreage of this soil is in native grass. This soil is suited to cultivation, but it is better suited to native grass. Capability unit IVe-1, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Geary silt loam, 11 to 31 percent slopes (GsE).—This somewhat excessively drained soil is on the sides of drainageways on uplands and on hills and bluffs along major streams. Many of the slopes are not smooth, and in

some places there are catsteps that have loess exposed at the surface. This soil has a profile similar to the one described as representative for the Geary series, except that the surface layer and subsoil are thinner. Exposures of sand and gravel are common.

Included with this soil in mapping were areas of soils that have a brown or light-brown surface layer, soils that have a subsoil 8 to 20 inches thick, and soils that are 15 to 26 inches deep to lime. As much as 15 percent of some mapped areas consists of Hobbs soils on the bottoms of drainageways. In a small area in the extreme southeastern part of the county, as much as 25 percent of some mapped areas consists of steep Coly soils.

This soil is moderately low in organic-matter content and medium in natural fertility. Runoff is rapid, and moisture intake is lower than it is in areas of less sloping soils.

Most of the acreage of this soil is in native grass used for grazing (fig. 9). Steepness makes this soil unsuitable for cultivation. Capability unit VIe-1, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Geary silty clay loam, 3 to 7 percent slopes, eroded (GeB2).—This well-drained soil is on hillsides and on the sides of drainageways on uplands. It has a profile similar to the one described as representative for the series, except that the surface layer is grayish-brown to brown silty clay loam 4 to 7 inches thick.

Included with this soil in mapping were areas of soils where the subsoil is 8 to 20 inches thick and areas where the depth to lime ranges from 20 to 26 inches. Also included were small areas of severely eroded Holder soils and small areas of Hobbs soils on the bottoms of drainageways.

This soil is low in natural fertility and organic-matter content. Runoff is medium. Water erosion is a hazard. This soil is difficult to work. It puddles if worked when too wet and is hard when dry. It has poor tilth. A good stand of row crops is difficult to establish.

All of the acreage of this soil has been cultivated, but some of it is now seeded to native grass. Wheat, grain sorghum, and alfalfa are the principal crops grown. Capability units IIIe-8, dryland, and IIIe-11, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Geary silty clay loam, 7 to 11 percent slopes, eroded (GeC2).—This well-drained soil is on the sides of drainageways on uplands. It has a profile similar to the one described as representative for the series, except that the surface layer is grayish-brown to brown silty clay loam 4 to 7 inches thick. Sand and gravel exposures are common.

Included with this soil in mapping were areas of soils in which the subsoil is 5 to 20 inches thick and soils in which the depth to lime ranges from 15 to 26 inches. Also included were small areas of severely eroded Holder soils. As much as 15 percent of some mapped areas consists of Hobbs soils on the bottoms of drainageways.

This soil is low in natural fertility and organic-matter content. Runoff is medium to rapid. Tilth is poor. The silty clay loam surface layer and steepness make this soil difficult to farm. It erodes readily. This soil puddles if worked when too wet and is hard when dry. Good stands of row crops are difficult to establish in some years.

All of the acreage of this soil has been cultivated, but much of it is now seeded to native grass. Wheat, grain sorghum, and alfalfa are the principal crops grown. Capability unit IVe-8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Figure 9.—Typical area of Geary silt loam, 11 to 31 percent slopes, in native grass. Actively eroding drainageways similar to the one pictured here are common in areas of this soil.

Hall Series

The Hall series consists of deep, well-drained soils that formed in calcareous loess. These are nearly level soils on uplands throughout the loess plains area of the county.

In a representative profile the surface layer is silt loam about 14 inches thick. The upper 7 inches has been disturbed in tillage and is grayish brown; the lower part is dark gray. The subsoil extends to a depth of 42 inches. It is grayish-brown, friable silty clay loam in the upper part; grayish-brown and brown, firm silty clay loam in the middle part; and pale-brown, friable silty clay loam in the lower part. The underlying material is pale-brown silt loam.

Hall soils have moderately slow permeability. Available water capacity is high. Natural fertility is high, and organic-matter content is moderate.

Most areas of these soils are cultivated. The soils are suited to all crops commonly grown in the county. They are well suited to irrigation, but in some areas the lack of available ground water limits the development of irrigation. Areas in native grass are used for grazing. Hall soils are well suited to trees and to habitat for wildlife.

Representative profile of Hall silt loam, 0.1 mile north and 50 feet west of the southeast corner of sec. 36, T. 5 N., R. 9 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, fine, crumb structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—7 to 14 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

B1—14 to 20 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to moderate, very fine, subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

B21t—20 to 28 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm; neutral; clear, smooth boundary.

B22t—28 to 35 inches, brown (10YR 5/3) silty clay loam, dark grayish-brown (10YR 4/2) moist; moderate, coarse, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

B3—35 to 42 inches, pale-brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure; slightly hard, friable; neutral; gradual, smooth boundary.

C—42 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure parting to massive; soft, very friable; mildly alkaline.

The solum ranges from 36 to 48 inches in thickness. The A horizon ranges from 12 to 18 inches in thickness and from dark gray to grayish brown in color. Soil material having dry colors of grayish brown or darker ranges from 20 to 30 inches in thickness and extends well into the B horizon. The B2t horizon is silty clay loam that contains 28 to 35 percent clay. The C horizon ranges from pale brown to light gray. Lime is below a depth of 60 inches.

The Hall soils are near Hastings and Hord soils. They have a less clayey B2t horizon than Hastings soils. They have a more clayey B horizon than Hord soils.

Hall silt loam (0 to 1 percent slopes) (Ha).—This soil is on uplands throughout the county.

Included with this soil in mapping were small areas where the surface layer is 18 to 30 inches thick. Also included were small areas of Hastings and Hord soils.

Surface runoff is slow. This soil absorbs water well and readily releases it to plants. It is easily worked.

Most areas of this soil are cultivated, and some are irrigated. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. Corn and grain sorghum are the main irrigated crops. Available zinc is low in areas where deep cuts, made during land leveling, have exposed the underlying loess material. Capability units IIc-1, dryland, and I-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings Series

The Hastings series consist of deep, well-drained soils that formed in calcareous loess. These are nearly level to gently sloping soils on uplands.

In a representative profile the surface layer is about 11 inches thick. The upper 8 inches is dark grayish-brown silt loam, and the lower part is dark grayish-brown heavy silt loam. The subsoil, which extends to a depth of 41 inches, is grayish-brown and brown heavy silty clay loam in the upper part and pale-brown silty clay in the lower part. It is hard when dry and firm when moist. The underlying material is very pale brown silt loam that is stained with iron. Free lime is at a depth of 41 inches.

Hastings soils have moderately slow permeability. Available water capacity is high. Natural fertility is medium, and organic-matter content is moderate. These soils are easy to work and are easily kept in good tilth.

Hastings soils are well suited to cultivated crops and to irrigation. They are suited to all crops commonly grown in the county. Some areas are still in native grass. These soils are well suited to trees and to use by wildlife.

Representative profile of Hastings silt loam, 0 to 1 percent slopes, 0.4 mile east and 50 feet south of the northwest corner of sec. 15, T. 6 N., R. 11 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—8 to 11 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark gray (10YR 3/1) moist; moderate, fine, granular structure; slightly hard, very friable; neutral; clear, smooth boundary.

B1—11 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, subangular blocky structure; slightly hard, friable; neutral; clear, smooth boundary.

B21t—14 to 21 inches, grayish-brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) moist, dark brown (10YR 4/3) crushed; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm; neutral; clear, smooth boundary.

B22t—21 to 29 inches, brown (10YR 5/3) heavy silty clay loam, dark grayish brown (10YR 4/2) moist, grayish brown (10YR 5/2) crushed; weak, coarse, subangular blocky structure parting to moderate, medium, angular blocky; hard, firm; neutral; gradual, wavy boundary.

B3—29 to 41 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard, friable; mildy alkaline; abrupt, wavy boundary.

C—41 to 60 inches; very pale brown (10YR 7/3) silt loam; pale brown (10YR 6/3) moist; weak, coarse, subangular blocky structure parting to massive; soft, very friable; yellowish-brown iron stains; strong effervescence; moderately alkaline.

The solum ranges from 30 to 44 inches in thickness. The A horizon is 8 to 12 inches thick. Its color ranges from grayish brown to dark grayish brown. Its reaction ranges from medium acid to neutral. The B horizon ranges from dark grayish brown to pale brown. The B2t horizon is 12 to 18 inches thick. It ranges from heavy silty clay loam to light silty clay and averages between 35 and 42 percent clay. Dark stains are on ped surfaces. The C horizon ranges from light brownish gray to very pale brown and has reddish-brown and yellowish-brown iron stains. Depth to lime ranges from 36 to 70 inches.

Hastings soils are near Holder and Crete soils. They are more clayey in the B2t horizon than Holder soils, but they are less clayey in the B2t horizon than Crete soils.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were a few areas of Hall, Crete, and Butler soils. As much as 15 percent of some areas mapped consists of Holder soils.

Surface runoff is slow. Soil blowing can be a hazard in winter and early in spring if the surface is left unprotected, but erosion generally is not a hazard.

Most of the acreage of this soil is cultivated. About 30 percent is irrigated. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. Corn and grain sorghum are irrigated. Deep cuts made during land leveling can expose the clayey subsoil or the underlying loess material. Such areas generally are low in available zinc. Capability units IIc-1, dryland, and I-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silt loam, 1 to 3 percent slopes (HsA).—This soil is on loess uplands. It has a profile similar to the one described as representative for the series, except that the subsoil is not so thick.

Included in mapping were some areas of eroded soils along upland drainageways. These soils have a grayish-brown to light brownish-gray silty clay loam surface layer that is less than 8 inches thick. Also included were a few small areas of Holder soils.

Surface runoff is medium, and erosion can be a hazard.

Most of the acreage of this soil is cultivated, and much of it is irrigated. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. Corn and grain sorghum are irrigated. Under irrigation, contour benches or contour furrow irrigation helps to control erosion and to conserve soil moisture. The content of zinc is low in areas where cuts made during land leveling have exposed the underlying loess material. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings Series, Thin Solum Variant

The Hastings series, thin solum variant, consists of deep, nearly level, well-drained soils that formed in calcareous loess on uplands.

In a representative profile the surface layer is grayish-brown silt loam about 7 inches thick. The subsoil extends to a depth of about 22 inches. It is light brownish-gray, firm heavy silty clay loam in the upper part and pale-brown, friable silty clay loam in the lower part. The underlying material is light-gray silt loam that is sustained with iron. Lime is at a depth of about 32 inches.

These soils have moderately slow permeability. Available water capacity is high. Natural fertility is medium to low, and organic-matter content is moderately low.

Most areas of these soils are cultivated. The soils are suited to all crops commonly grown in the county. They respond well to irrigation. Areas in native grass are used for grazing. Soils of this variant can also be used for trees and as habitat for wildlife.

Representative profile of Hastings silt loam, thin solum variant, 0.7 mile south and 100 feet east of the northwest corner, sec. 29, T. 6 N., R. 11 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; slightly hard, friable; neutral; abrupt, smooth boundary.

B2t—7 to 16 inches, light brownish-gray (10YR 6/2) heavy silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

B3—16 to 22 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; slightly hard, friable; mildly alkaline; gradual, smooth boundary.

C1—22 to 32 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure; soft, very friable; yellowish-brown iron stains; mildly alkaline; abrupt, wavy boundary.

C2—32 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable; yellowish-brown iron stains; scattered accumulations of soft lime; strong effervescence; moderately alkaline.

The solum ranges from 16 to 26 inches in thickness. The A horizon ranges from grayish brown to dark grayish brown in color and from silt loam to silty clay loam in texture. Its thickness ranges from 5 to 9 inches but averages about 7 inches. The B horizon is 9 to 17 inches thick. The B2t horizon is heavy silty clay loam to light silty clay and averages between 35 to 42 percent clay. It ranges from 6 to 9 inches in thickness. The C horizon is light gray to very pale brown and has yellowish-brown iron stains. Depth to lime ranges from 18 to 32 inches.

Hastings soils, thin solum variant, are near Kenesaw and Hastings soils. They have a silty clay loam B horizon that is finer textured than the AC and C1 horizons that are of comparable depths in the Kenesaw soils. They have a thinner solum than Hastings soils.

Hastings silt loam, thin solum variant (0 to 1 percent slopes) (2Hs).—This soil is on uplands. It is nearly level except for some areas that are marked by small, scattered, low hummocks.

Included with this soil in mapping were a few small areas of Kenesaw and Hastings soils.

Surface runoff is slow. On about half of the acreage, this soil is easy to work and has good tilth. On the rest of the acreage, tillage has mixed the original surface layer with some of the subsoil. In these areas the present surface layer is sticky when wet and hard when dry, and tilth is poor. The soil puddles readily if it is worked when too wet. It becomes hard and cloddy if worked when dry. Good stands of row crops are hard to establish in some areas.

Most of the acreage of this soil is cultivated, and much of it is irrigated. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. Corn and grain sorghum are irrigated. The soil is low in available zinc where the subsoil or underlying loess material has been exposed. Capability units IIc–1, dryland, and I–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hersh Series

The Hersh series consists of deep, well-drained soils on uplands. These soils formed in loam material in areas that are between the sandhills and loess plains. Slopes range from 1 to 7 percent.

In a representative profile the surface layer is light brownish-gray fine sandy loam about 8 inches thick. The underlying material is brown fine sandy loam that grades to pale-brown sandy loam at a depth of about 42 inches. It is soft when dry and very friable when moist.

Hersh soils have moderately rapid permeability. Available water capacity is moderate. Organic-matter content and natural fertility are low. These soils are easy to work, but soil blowing is a hazard if the surface is left unprotected.

Most of the acreage of these soils is cultivated. Hersh soils are suited to all crops commonly grown in the county and are suited to irrigation. Some areas remain in native grass. The soils are well suited to trees if soil blowing is controlled. They can be used as a source of food and habitat for wildlife.

Representative profile of Hersh fine sandy loam, 3 to 7 percent slopes, 0.4 mile north and 50 feet west of the southeast corner, sec. 8, T. 7 N., R. 12 W.:

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

C1—8 to 42 inches, brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; soft, very friable; neutral; gradual, smooth boundary.

C2—42 to 60 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure; soft, very friable; mildly alkaline.

The solum ranges from 8 to 14 inches in thickness. The A horizon ranges from dark grayish brown to light brownish gray in color and from 5 to 8 inches in thickness. Its texture is fine sandy loam or loamy fine sand. In profiles that have an AC horizon, the AC horizon is grayish-brown to brown fine sandy loam as much as 6 inches thick. Most profiles lack an AC horizon and have an abrupt boundary

between the Ap horizon and the C horizon. The C horizon is stratified with loam to find sand in many places.

Hersh soils are near Valentine, Anselmo, and Kenesaw soils. They are finer textured than Valentine soils and coarser textured than Kenesaw soils. They have a lighter colored A horizon than Anselmo soils and lack the B horizon of those soils.

Hersh fine sandy loam, 3 to 7 percent slopes (HmB).—This soil is on uplands near the sandhills and it formed in hummocky, wind-deposited sand. It has the profile described as representative for the series.

Included with this soil in mapping were some areas of soils that are underlain by calcareous silt loam material at a depth below 24 inches. Also included were some areas where the surface layer is loamy fine sand.

Surface runoff is medium. Soil blowing is a hazard in cultivated areas. Areas of the soil tend to be unstable during periods of high winds if the surface is left unprotected. The soil also tends to be somewhat droughty.

About 85 percent of the acreage of this soil is cultivated. The soil is well suited to sprinkler irrigation, but some areas are gravity irrigated. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. Some corn and grain sorghum are irrigated. The remaining area is in native grass and is used for grazing. Capability units IIIe–3, dryland, and IIIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Hersh-Kenesaw complex, undulating (0 to 3 percent slopes) (HR).—This complex is mostly on uplands near areas of the sandhills. The areas are hummocky. About 55 percent of the complex is Hersh fine sandy loam, and 45 percent is Kenesaw silt loam. The gently sloping Hersh soils are on low ridges and hummocks, and the nearly level Kenesaw soils are in swales between the hummocks. The soils in this complex have profiles similar to those described as representative for their respective series.

Included with these soils in mapping were small areas of Kenesaw soils that have a surface layer of fine sandy loam or loamy fine sand. About half the acreage of the Hersh soils in these areas is underlain by silty loess material at a depth below 24 inches.

Surface runoff is slow to medium. Soil blowing and water erosion are hazards if the surface is left unprotected. The soils in this complex are easy to work.

Most of the acreage is cultivated. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. These soils are suited to sprinkler irrigation. Land grading is needed before they can be gravity irrigated. Capability units IIe–3, dryland, and IIe–3, irrigated; Hersh soil is in the Sandy range site and Sandy windbreak suitability group; Kenesaw soil is in the Silty range site and the Silty to Clayey windbreak suitability group.

Hobbs Series

The Hobbs series consists of deep, well-drained soils that that formed in silty alluvium. These soils are on narrow bottom lands along intermittent drainageways and on wide bottom lands along perennial streams in the valleys. Slopes are mostly less than 1 percent but range to 3 percent. Hobbs soils along intermittent drainageways are occasionally flooded after heavy rainstorms, but the floodwaters recede within a few hours. Low-lying areas along perennial streams are flooded for longer periods. Hobbs soils on higher bottom lands are seldom flooded. In most places the water table is below a depth of 15 feet, but along the Little Blue River it is commonly at a depth of less than 15 feet.

In a representative profile the surface layer is silt loam about 45 inches thick. The upper 15 inches in grayish brown; the next 8 inches is dark gray; the next 7 inches is dark grayish brown; and the lower 15 inches is very dark gray. This layer is soft when dry and very friable when moist. The underlying material is light brownish-gray silt loam.

Hobbs soils have moderate permeability. Organic-matter content is moderate, and natural fertility is high. Available water capacity is high.

Most areas of Hobbs soils are cultivated. These soils are suited to all crops commonly grown in the county. In areas that are subject to flooding, the kinds of crops grown are influenced by the frequency and the time of year that most flooding occurs. The soils respond well to irrigation. The rest of the acreage is in native grass or trees. Hobbs soils are well suited to grass and trees, but flooding can be a hazard in some places. Some kinds of wildlife use these areas as habitat and a source of food.

Representative profile of Hobbs silt loam, in a cultivated field, 2,540 feet west and 0.15 mile south of the northeast corner, sec. 33, T. 7 N., R. 11 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—7 to 15 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; soft, very friable; neutral; clear, smooth boundary.

A13—15 to 23 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft, very friable; neutral; clear, smooth boundary.

A14—23 to 30 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, crumb; soft, very friable; neutral; clear, smooth boundary.

Ab—30 to 45 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, granular; soft, very friable; neutral; gradual, smooth boundary.

C—45 to 60 inches, light brownish-gray (10YR 6/2) silt loam, dark gray (10YR 4/1) moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; soft, very friable; neutral.

The solum ranges from 28 to 50 inches in thickness. The A1 horizon ranges from 18 to 36 inches in thickness. Buried A horizons that are very dark gray to dark gray add to the total thickness of the A horizon. In areas of recent overwash, the surface layer is light gray to pale brown and is sandy in places. Platy structure is common in the A horizon. The C horizon is grayish-brown to light-gray loam or silt loam and is stratified in places with textures ranging from sandy loam to silty clay loam. Free lime is in the C horizon in some profiles.

Hobbs soils are near Cass and Hord soils. They are finer textured than Cass soils. Hobbs soils lack the B horizon of Hord soils and are lower on the landscape than those soils.

Hobbs silt loam (0 to 1 percent slopes) (Hv).—This soil is on bottom lands along the larger streams in the valleys. It has the profile described as representative for the series. Included in mapping were a few small areas of Cass and Hord soils.

Surface runoff is medium. This soil is easy to work, and tilth is good.

Nearly all the acreage of this soil is cultivated. The soil responds well to irrigation. Grain sorghum, wheat, corn, and alfalfa are grown under dryland management. Corn and grain sorghum are the principal irrigated crops. Capability units I–1, dryland, and I–2, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silt loam, occasionally flooded (0 to 3 percent slopes) (2Hb).—This soil is on alluvial bottoms of upland drainageways and perennial streams. It is subject to flooding, but most of the floods are of short duration. This soil has a profile similar to the one described as representative for the series, except that the surface layer is silt loam stratified with thin layers of fine sandy loam to silty clay loam. The underlying material is stratified with fine sand to silty clay and has reddish-brown mottles in some places.

Included with this soil in mapping were a few areas of Silty alluvial land and small areas of Cass soils. Also included were a few wet areas in which the water table is within a few feet of the surface. Such areas are in old remnants of stream channels. Some old river channels that are filled with sediment have a silty clay or clay surface layer.

Surface runoff is medium. This soil is subject to flooding, but floodwaters drain quickly after streams recede. Flooding seldom causes a complete loss of a crop, but it can affect harvest or planting.

Most of this soil is cultivated, but some of it is in native grass. Grain sorghum, corn, and alfalfa are the main crops. Wheat is not grown extensively, because of the hazard of flooding. This soil is suited to irrigation if it is protected from flooding. In years when rainfall is below normal, the additional moisture can be beneficial, especially for pasture or hayland. Much of the area of this soil along the perennial streams is covered with grass and a good growth of trees or shrubs. These areas are used mostly for grazing, but they also provide a good habitat for wildlife. Capability units IIw–3, dryland, and IIw–3, irrigated; Silty Overflow range site; Moderately Wet windbreak suitability group.

Holder Series

The Holder series consists of deep, well-drained soils that formed in loess on uplands (fig. 10). Slopes range from 0 to 11 percent.

In a representative profile the surface layer is silt loam about 10 inches thick. The upper 6 inches has been disturbed by tillage and is gray; the lower part is dark gray. The subsoil, which extends to a depth of 30 inches, is dark grayish-brown light silty clay loam in the upper part, grayish-brown light silty clay loam in the middle, and light brownish-gray silt loam in the lower part. It is slightly hard when dry and friable when moist. The underlying material is pale-brown to light-gray silt loam. Free lime is at a depth of 38 inches.

Holder soils have moderate permeability. Available water capacity is high. Natural fertility is medium to low, and organic-matter content is moderate to low. These soils are easy to work.

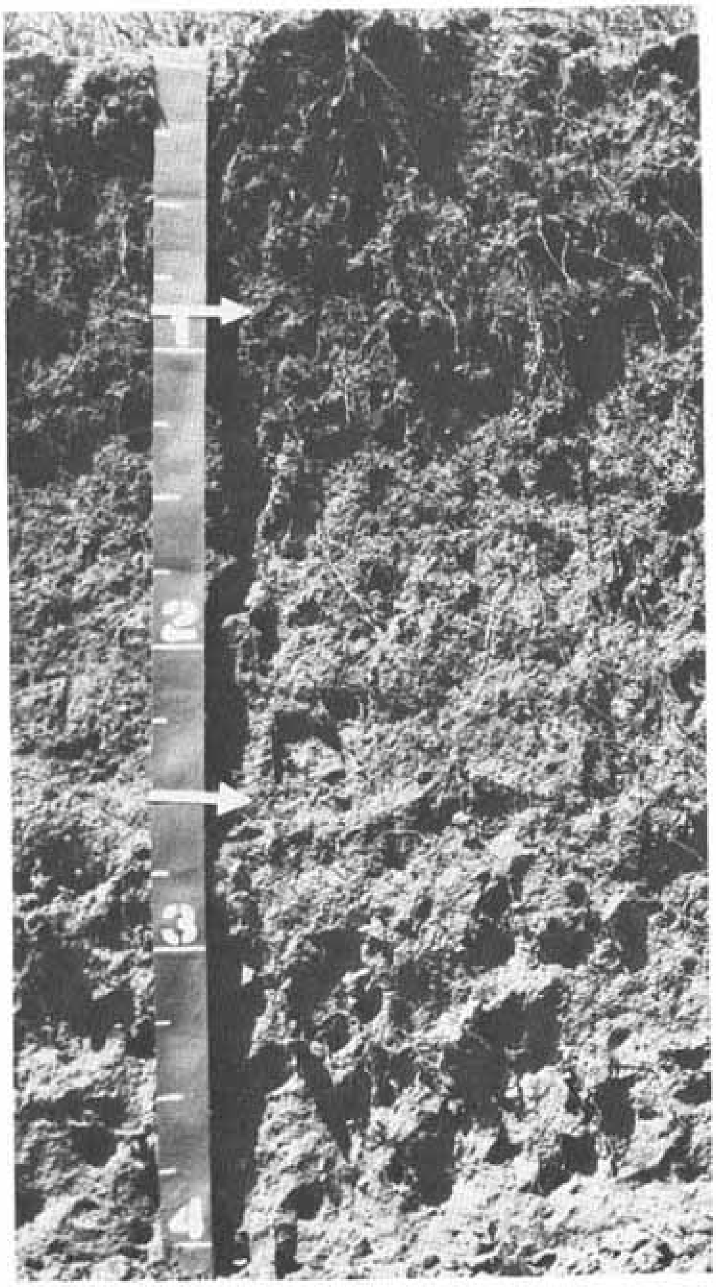


Figure 10.—Profile of a Holder silt loam. The light silty clay loam subsoil is easily penetrated by plant roots, air, and water. Pointers indicate lower boundaries of surface layer and subsoil.

Holder soils are used mostly for cultivated crops. They are well suited to irrigation and to all crops commonly grown in the county. Some areas are in native grass. These soils are well suited to trees and are a source of food for wildlife.

Representative profile of Holder silt loam, 1 to 3 percent slopes, 0.3 mile north and 100 feet east of the southwest corner of sec. 9, T. 7 N., R. 11 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B1—10 to 14 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B2t—14 to 23 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; slightly hard, friable; mildly alkaline; clear, smooth boundary.

B3—23 to 30 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure; slightly hard, friable; mildly alkaline; gradual, smooth boundary.

C1—30 to 38 inches, pale-brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure; soft, very friable; mildly alkaline; abrupt, wavy boundary.

C2—38 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; yellowish-brown iron stains; strong effervescence; moderately alkaline.

The solum ranges from 25 to 48 inches in thickness. The A horizon is 7 to 15 inches thick. It ranges from dark gray to grayish brown. In eroded and severely eroded areas, there is a grayish-brown to brown silt loam to light silty clay loam A horizon that is less than 7 inches thick. The B2t horizon ranges from 9 to 12 inches in thickness. It is light silty clay loam that has a clay content of 28 to 35 percent. The C horizon is pale brown to very pale brown or light gray and has yellowish-brown iron stains. In some areas reddish-brown concretions and soft lime accumulations are scattered throughout the C horizon below a depth of 36 inches. Depth to lime averages about 45 inches but ranges from 36 inches to more than 60 inches.

In mapping units HgB2, HgB3, and HgC3, the surface layer is thinner and lighter in color than is defined in the range for the series, but this difference does not alter the usefulness or behavior of the soils.

Holder soils are near Hastings and Kenesaw soils. They have a more friable, less clayey B2t horizon than Hastings soils. They have a B horizon, which is lacking in Kenesaw soils.

Holder silt loam, 0 to 1 percent slopes (Hg).—This soil is on uplands. It has a profile similar to the one described as representative for the series, except that the subsoil is slightly thicker.

Included with this soil in mapping were small areas that have a surface layer 15 to 20 inches thick. Also included were small areas of Hastings and Hord soils and areas where 6 to 12 inches of light-colored loess has been deposited on the surface.

Runoff is slow. Soil blowing can be a hazard in winter and early in spring if the soil is left unprotected. The soil is moderate in organic-matter content and medium in natural fertility. It is easy to work and has good tilth.

Most of the acreage of this soil is cultivated, and much of it is irrigated. Wheat, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are irrigated. This soil is deficient in zinc in areas of deep cuts made by land leveling. Capability units IIc–1, dryland, and I–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holder silt loam, 1 to 3 percent slopes (HgA).—This soil is mostly on hillsides and ridgetops. It has the profile described as representative for the series. Included in mapping were small areas of soils that have a surface layer of light silty clay loam 4 to 7 inches thick.

Runoff is medium, and water erosion is a hazard in some places. This soil is moderate in organic-matter content and medium in natural fertility.

Most of the acreage of this soil is cultivated, and much of it is irrigated. Wheat, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are the main irrigated crops. Land grading generally is needed to reduce or smooth the slopes for irrigation. Zinc is needed in areas where deep cuts have exposed the underlying loess. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holder silt loam, 3 to 7 percent slopes (HgB).—This soil is on ridgetops, hillsides, and sides of drainageways on uplands. The profile of this soil is similar to the one described as representative for the series, except that the subsoil is not so thick.

Included with this soil in mapping were small areas of soils that have a surface layer of grayish-brown light silty clay loam.

Runoff is medium, and erosion is a hazard if this soil is cultivated. Natural fertility is medium, and organic-matter content is moderate.

This soil is suitable for cultivation, but most of the acreage is in native grass. Wheat, grain sorghum, corn, and alfalfa are the principal crops. This soil is well suited to sprinkler irrigation. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holder silt loam, 3 to 7 percent slopes, eroded (HgB2).—This soil is on hillsides and the sides of drainageways (fig. 11) on uplands. It has a profile similar to the one described as representative for the series, except that the surface layer is 4 to 7 inches thick.

Included with this soil in mapping were areas of soils that have a surface layer of light silty clay loam. Also included were small areas of soils where the underlying material of pale-brown to very pale brown silt loam is exposed. In addition, some areas of soils that have lime within 36 inches of the surface were included.

Organic-matter content is moderately low, and natural fertility is medium. Runoff is medium. Water erosion is a hazard. In some eroded areas this soil has poor tilth, and as a result, good stands of row crops are difficult to establish is some years.

Most of the acreage of this soil is cultivated. Grain sorghum, wheat, and alfalfa are the principal crops. This soil is suited to sprinkler irrigation, or it can be bench-leveled for gravity irrigation. Some areas of this soil have been seeded to native grasses. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holder silt loam, 7 to 11 percent slopes (HgC).—This soil is on the sides of drainageways on uplands. The profile of this soil is similar to the one described as representative for the series, except that the surface layer and subsoil are not so thick.

Included with this soil in mapping were areas where lime is at a depth ranging from 20 to 36 inches. Also included were small areas of Coly and Geary soils and areas of Hobbs soils on the bottoms of the drainageways.

Runoff is medium to rapid. Erosion is a hazard if this soil is cultivated. Organic-matter content is moderate, and natural fertility is medium.

Figure 11.—Holder silt loam, 3 to 7 percent slopes, eroded, on a terraced hillside. Grain sorghum, planted on the contour, is grown under dryland management. Hord silt loam, terrace, 0 to 1 percent slopes, is on the stream terrace in the background.

Most of the acreage of this soil is in native grass. A few areas are cultivated, and wheat, grain sorghum, and alfalfa are the principal crops. Capability unit IVe-1, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Holder silty clay loam, 3 to 7 percent slopes, severely eroded (HgB3).—This soil is on hillsides and the sides of drainageways on uplands. The profile of this soil is similar to the one described as representative for the series, except that the surface layer is grayish-brown to brown light silty clay loam 4 to 6 inches thick.

Included with this soil in mapping were areas where depth to lime ranges from 16 to 36 inches. Also included were a few small areas of Coly soils.

Runoff is medium. Water erosion is a severe hazard. Erosion has removed nearly all of the original surface layer and much of the subsoil, and in places the underlying material is exposed. Organic-matter content and natural fertility are low. Tilth is poor. This soil is difficult to work, and good stands of row crops are difficult to establish in some years. Most areas of this soil have numerous small gullies.

Most of the acreage of this soil is cultivated. Some has been seeded to native grasses and is used for grazing. The surface layer puddles if worked when too wet, and it becomes slightly hard when dry. Wheat, grain sorghum, and alfalfa are the principal crops. This soil is suited to sprinkler irrigation, or it can be bench-leveled for gravity irrigation. Capability units IIIe-8, dryland, and IIIe-11, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holder silty clay loam, 7 to 11 percent slopes, severely eroded (HgC3).—This soil is on the sides of drainageways on uplands (fig. 12). It has a profile similar to the one described as representative for the series, except that the surface layer is grayish-brown to brown light silty clay loam 4 to 6 inches thick.

Included with this soil in mapping were areas where the depth to lime ranges from 12 to 36 inches. Also included were small areas of Coly and Geary soils. As much as 15 percent of some mapped areas consists of Hobbs soils.

Runoff is medium to rapid, and water erosion is a severe hazard. In most areas erosion has removed all of

Figure 12.—An area of Holder silty clay loam, 7 to 11 percent slopes, severely eroded, along an upland drainageway. Included soil on bottom of drainageway is Hobbs silt loam, occasionally flooded.

the original surface layer and much of the subsoil, and in places the underlying material is exposed. Small, crossable gullies are numerous. Organic-matter content and natural fertility are low. Tilth is poor. The soil is difficult to work, and good stands of row crops are difficult to establish. The surface layer puddles if worked when too wet, and it is slightly hard when dry.

All of the acreage has been cultivated, but much of it is now seeded to native grasses used for grazing. Wheat and alfalfa are the most suitable crops, but grain sorghum also is grown. Capability unit IVe–8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Hord Series

The Hord series consists of deep, well-drained soils that formed in loess, silty alluvium, or a mixture of loess and alluvium. These are nearly level to gently sloping soils on stream terraces and uplands. The most extensive area of Hord soils is on the stream terrace along the Little Blue River.

In a representative profile the surface layer is silt loam about 15 inches thick. The upper 6 inches has been disturbed by tillage and is gray; the lower part is dark gray. The subsoil, which extends to a depth of 50 inches, is dark-gray silt loam in the upper part and gray silt loam in the lower part. It is slightly hard when dry and very friable when moist. The underlying material is light brownish-gray silt loam.

Hord soils have a high available water capacity. Permeability is moderate. Organic-matter content is moderate, and natural fertility is high. Tilth is good, and the soils are easily worked.

Hord soils are suited to all crops commonly grown in the county and are easily developed for irrigation. They respond well to irrigation and fertilizer. Some areas are in native grass. These soils are suitable as sites for trees.

Representative profile of Hord silt loam, terrace, 0 to 1 percent slopes, 300 feet south and 50 feet west of the northeast corner of sec. 15, T. 5 N., R. 11 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—6 to 15 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; soft, very friable; neutral; clear, smooth boundary.

B2—15 to 30 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, very friable; neutral; gradual, smooth boundary.

B3—30 to 50 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; weak, coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; slightly hard, very friable; neutral; gradual, smooth boundary.

C—50 to 60 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to massive; soft, very friable; neutral.

The solum ranges from 36 to 55 inches in thickness. It is neutral to mildly alkaline. Soil material having dry colors of grayish brown or darker ranges from 20 to 30 inches in thickness and extends well into the B horizon. The A horizon ranges from 10 to 16 inches in thickness and is dark gray to grayish brown. The B horizon is dark gray to pale brown. The B2 horizon ranges from silt loam to light silty clay loam. The C horizon is light brownish gray to light gray. In most places it is noncalcareous, but free lime is at a depth of 48 to 60 inches in some areas. On stream terraces, the C horizon is commonly stratified with loamy sand to silty clay loam. Where the soils are on uplands, the C horizon is silt loam that is stained with iron. Buried soils are common.

Hord soils are near Holder, Hobbs, and Kenesaw soils. They typically have a less clayey B horizon than Holder soils. Hord soils are less stratified than Hobbs soils and have a B horizon that is lacking in the Hobbs and Kenesaw soils.

Hord silt loam, 0 to 1 percent slopes (Hd).—This soil formed in calcareous loess on uplands. It has a profile that is similar to the one described as representative for the series, except that it has a light silty clay loam subsoil and the underlying material is silt loam loess.

Included with this soil in mapping were areas where the surface layer is 16 to 32 inches thick. These areas commonly have light-gray silt loam material in the upper 20 inches. Also included are a few small areas of Holder and Kenesaw soils.

This soil is easily worked. Surface runoff is slow, and water erosion is not a hazard. In dryfarmed areas there is a shortage of moisture in most years. Conserving moisture is the main concern if the soil is dryfarmed.

Nearly all of the acreage of this soil is cultivated, and some of it is irrigated. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. Corn and grain sorghum are irrigated. This soil is easily developed for irrigation. Areas in native grass are used mostly for grazing. Capability units IIc–1, dryland, and I–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord silt loam, terrace, 0 to 1 percent slopes (2Hd).—This soil formed in silty alluvium or a mixture of loess and alluvium on stream terraces along the major drainageways. It has the profile described as representative for the series.

Included with this soil in mapping were some areas of soils on stream terraces along the Little Blue River in which the subsoil is heavy silty clay loam that has lime at a depth of 20 to 30 inches. Also included are a few small areas of Hobbs soils.

Surface runoff is slow. In dryfarmed areas there is a shortage of moisture in most years and conserving moisture is a major concern.

Most of the acreage of this soil is cultivated, and much of it is irrigated. Crops respond well to irrigation. Only a little land shaping is required for gravity irrigation. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. Corn and grain sorghum are irrigated. Areas in native grass are used for grazing or hay. Capability units IIc–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord silt loam, terrace, 1 to 3 percent slopes (2HdA).—This soil is on alluvial foot slopes along upland breaks and on the sides of shallow drainageways that cross the stream terraces. It has a profile similar to the one described as representative for the series, except that it has a thinner subsoil. Included in mapping were a few small areas of Hobbs soils.

Surface runoff is medium, and erosion can be a hazard.

Nearly all the acreage of this soil is cultivated. If the soil is developed for irrigation, it generally requires more land grading than other Hord soils. Wheat, grain sor-

ghum, and alfalfa are the main dryfarmed crops. Corn and grain sorghum are irrigated. Native grass areas are used for grazing. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Inavale Series

The Inavale series consists of deep, excessively drained soils that formed in loamy and sandy alluvium, much of which has been reworked by wind to form low hummocks. These are nearly level to gently sloping soils, mainly on bottom lands along Sand and Cottonwood Creeks and along small drainageways or swales in the sandhills. A few areas are on the bottom lands along the Little Blue River. Low-lying areas are subject to occasional flooding. The water table is at a depth of 5 to 20 feet.

In a representative profile the surface layer is grayish-brown loamy fine sand about 6 inches thick. Next is a transitional layer of loose, brown loamy sand that extends to a depth of 12 inches. The underlying material is pale-brown fine sand grading to light-gray fine sand that is stratified with fine sandy loam and loamy sand at a depth of 36 inches.

Inavale soils have rapid permeability. Natural fertility and organic-matter content are low. Available water capacity is low.

These soils are used mostly for range, but some areas are cultivated. The soils also are suited to trees in windbreaks and to use by wildlife.

Representative profile of Inavale loamy fine sand, 0.3 mile north and 0.4 mile west of the southeast corner of sec. 34, T. 6 N., R. 12 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; loose, very friable; neutral; abrupt, smooth boundary.

AC—6 to 12 inches, brown (10YR 5/3) loamy sand, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure parting to single grained; loose; neutral; gradual, smooth boundary.

C1—12 to 36 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; neutral; gradual, smooth boundary.

C2—36 to 60 inches, light-gray (10YR 7/2) fine sand stratified with lenses of fine sandy loam and loamy sand, grayish brown (10YR 5/2) moist; single grained; loose; neutral.

The solum ranges from 10 to 22 inches in thickness. The A horizon ranges from 4 to 10 inches in thickness. It is dark grayish-brown to brown loamy fine sand or fine sandy loam. The AC and C horizons range from grayish brown and brown to white. Their texture ranges from loamy fine sand to sand. The C horizon is stratified with silty clay loam to sand. It is neutral to mildly alkaline. In some places the C horizon has reddish-brown or yellowish-brown mottles below a depth of 40 inches.

Inavale soils are near Valentine and Cass soils. They are more stratified and are lower on the landscape than Valentine soils. Inavale soils have a thinner A horizon and are coarser textured than Cass soils.

Inavale fine sandy loam (0 to 3 percent slopes) (In).—This soil is hummocky. It has a profile similar to the one described as representative for the series, except that the surface layer is fine sandy loam.

Included with this soil in mapping were a few areas where the surface layer is loamy fine sand or silt loam. Also included were small areas of Cass soils.

Surface runoff is slow. This soil is easily worked, but it tends to be droughty if dryfarmed. Soil blowing is a hazard in cultivated areas. Some low-lying areas are subject to occasional flooding.

This soil is mostly in native grass and is used for grazing. Only a few areas are cultivated. Wheat and grain sorghum are the principal crops. This soil is suited to sprinkler irrigation. Capability units IIIe–3, dryland, and IIIe–3, irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Inavale loamy fine sand (0 to 3 percent slopes) (Ig).—This hummocky soil is on bottom lands. It has the profile described as representative for the series.

Included with this soil in mapping were a few small areas of soils that have a fine sandy loam to silt loam surface layer, a few areas of soils in which the underlying material is silt loam or silty clay loam below a depth of 30 inches, and some small areas of soils along Sand Creek that are affected by a water table in wet years. Also included were some small areas of Cass and Valentine soils.

Surface runoff is slow to very slow. If this soil is cultivated, soil blowing is a hazard. This soil is droughty and tends to be difficult to cultivate because of its looseness. Low-lying areas are subject to occasional flooding.

Most of the acreage of this soil is in native grass. The soil occurs mostly as small, irregular areas along drainageways, and this makes cultivation impractical. Only a few areas are large enough for cultivation. Wheat and grain sorghum are the principal dryfarmed crops. This soil is suited to sprinkler irrigation. Some areas that were cultivated have been reseeded to native grasses and are used mostly for grazing. Capability units IIIe–5, dryland, and IIIe–5, irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Kenesaw Series

The Kenesaw series consists of deep, well-drained soils that formed in young loess on uplands or in mixed loess and alluvium on stream terraces (fig. 13). Slopes range from 0 to 7 percent. Most areas are hummocky.

In a representative profile the surface layer is grayish-brown silt loam about 8 inches thick. Next is a transitional layer of pale-brown silt loam 8 inches thick. It is soft when dry and very friable when moist. The underlying material is light-gray silt loam. Free lime is at a depth of 28 inches.

Kenesaw soils have moderate permeability. Available water capacity is high. Organic-matter content is moderately low to low, and natural fertility is medium to low. The pattern of surface drainage is not well defined in some areas.

These soils are used mostly for cultivated crops. They respond well to irrigation and fertilizer, but land grading generally is needed before the soils can be gravity irrigated. Leveled areas are deficient in zinc. Kenesaw soils are suited to all crops commonly grown in the county. Hummocky or irregular slopes make some areas difficult to manage. Some areas remain in native grass. Kenesaw soils are well suited to trees, and they can be used by wildlife and for recreation.

Representative profile of Kenesaw silt loam, 0 to 1 percent slopes, 0.4 mile north and 140 feet east of the southwest corner of sec. 27, T. 7 N., R. 12 W.:

Figure 13.—**Profile of a Kenesaw silt loam. This soil is easily penetrated by roots, and it has a high available water capacity. Pointers indicate lower boundaries of surface layer and transitional zone.**

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—6 to 8 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; soft, very friable; neutral; abrupt, smooth boundary.

AC—8 to 16 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; soft, very friable; neutral; gradual, wavy boundary.

C1—16 to 28 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; few, fine, faint iron stains; weak, coarse, subangular blocky structure; soft, very friable; mildly alkaline; abrupt, wavy boundary.

C2—28 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; few, fine, faint iron stains; weak, coarse, subangular blocky structure parting to massive; soft, very friable; strong effervescence; moderately alkaline.

The A horizon ranges from 8 to 10 inches in thickness and from dark gray to grayish brown in color. The AC horizon is loam or silt loam 4 to 10 inches thick. It ranges from grayish brown to pale brown. The C horizon is light gray to very pale brown. The C horizon is mostly silt loam, loam, or very fine sandy loam, but in some areas it is thinly stratified with silty clay loam to sand. Depth to lime ranges from 15 to 48 inches. Yellowish or reddish-brown iron stains are common in the C horizon.

The Kenesaw soils are near Coly, Hersh, Holder, and Rusco soils. They are more deeply leached of lime than Coly soils. Kenesaw soils are finer textured than Hersh soils. They are less clayey than Holder soils and lack the B horizon of those soils. They are better drained and lack the B horizon of Rusco soils.

Kenesaw silt loam, 0 to 1 percent slopes (Ks).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were a few small areas where the surface layer is fine sandy loam; some areas where there is a buried soil at a depth of 2 to 5 feet; and a few small areas of Holder and Rusco soils.

Surface runoff is slow. Organic-matter content is moderately low, and natural fertility is medium. Conserving moisture is a concern if this soil is dryfarmed. Soil blowing can be a hazard in winter and early in spring if the soil is left unprotected. Dry-farmed areas lack adequate moisture in most years.

Most of the acreage of this soil is cultivated. The soil is well suited to irrigation, but a small amount of land grading is needed to prepare it for gravity irrigation. Available zinc is low in areas where deep cuts have exposed the underlying material. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. Corn and grain sorghum are irrigated. Capability units IIc–1, dryland, and I–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Kenesaw silt loam, 1 to 3 percent slopes (KsA).—This soil formed in loess on uplands. Most areas are hummocky. It has a profile similar to the one described as representative for the series, except that lime is closer to the surface.

Included with this soil in mapping were areas where the surface layer is light brownish-gray to pale-brown silt loam or loam 4 to 8 inches thick and small areas where the surface layer is 6 to 24 inches of fine sandy loam. Also included were a few small areas of Hersh soils.

Surface runoff is medium. Erosion is a hazard in some places. Organic-matter content is moderately low to low, and natural fertility is medium to low. Tilth is poor in some areas. The hummocky, irregular slopes make terracing difficult. Returning crop residue to the soil improves tilth and increases the content of organic matter.

Most areas of this soil are cultivated. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. This soil is suited to gravity and sprinkler irrigation. Corn and grain sorghum are irrigated. Most areas need to be leveled for gravity irrigation. Many of the hummocky areas of this soil that have been leveled for irrigation have slopes of 1 percent or less after leveling. The content of zinc is low in areas where deep cuts have exposed the underlying material. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Kenesaw silt loam, 3 to 7 percent slopes (KsB).—This soil is mostly on the sides of hills and drainageways on uplands. Some areas are hummocky. This soil has a profile similar to the one described as representative for the series, except that lime is closer to the surface.

Included in mapping were areas where the surface layer is light brownish-gray to pale-brown silt loam or loam 4 to 8 inches thick, areas where the soils are noncalcareous to a depth of 60 inches or more, and small areas of soils that have 6 to 24 inches of fine sandy loam at the surface. Also included were small areas of Coly and Hersh soils.

Surface runoff is medium, and erosion is a hazard. Organic-matter content and natural fertility are low. Tilth is poor in some areas. Some hillsides have numerous small gullies. Irregular slopes in some areas make terracing difficult.

About 75 percent of the acreage of this soil is cultivated. Wheat, grain sorghum, and alfalfa are the principal dryfarmed crops. An extensive amount of land grading is needed to prepare this soil for gravity irrigation. Contour bench are suitable on some hillsides. Some small areas are sprinkler irrigated. Corn and grain sorghum are the main irrigated crops. Leveled areas are commonly deficient in zinc. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Kenesaw silt loam, terrace, 0 to 1 percent slopes (2Ks).—This soil formed in silty alluvium or a mixture of loess and alluvium. It is mainly on stream terraces along the Platte River and Cottonwood Creek. Some small, scattered areas are on the stream terrace along the Little Blue River. This soil has a profile similar to the one described as representative for the Kenesaw series, except that the underlying material is very fine sandy loam or silt loam that is thinly stratified with silty clay loam to sand.

Included with this soil in mapping were a few areas of soils that have a subsoil of silty clay loam, a few areas of soils on the Platte River stream terrace that have sand or coarse sand and gravel at a depth below 20 inches, and a few areas of soils that have a surface layer of fine sandy loam. The sandy areas are shown on the soil map by special symbol. Also included were a few small areas of Anselmo and Rusco soils.

Surface runoff is slow. Organic-matter content is moderately low, and natural fertility is medium. Conserving soil moisture and maintaining high fertility are the main concerns of management.

Most areas of this soil are cultivated. This soil is well suited to irrigation and does not require extensive land leveling for gravity irrigation. Wheat, grain sorghum, and alfalfa are the main dryfarmed crops. Corn and grain sorghum are irrigated. Capability units IIc–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Lex Series

The Lex series consists of nearly level, moderately deep, somewhat poorly drained soils that formed in recent alluvium. These soils are on bottom lands along the Platte River. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile the surface layer is silt loam about 9 inches thick. The upper 5 inches has been disturbed in tillage and is grayish brown; the lower part is gray. Next is a transitional layer of light brownish-gray, calcareous silt loam about 9 inches thick. It is slightly hard when dry and very friable when moist. The underlying material is pale-brown fine sandy loam that has yellowish-brown mottles. At a depth of 22 inches, it grades to light-gray coarse sand and gravel.

Lex soils have moderate permeability in the upper part and very rapid permeability in the underlying coarse sand and gravel. Organic-matter content is moderate, and natural fertility is medium to low. Available water capacity is slow.

Most areas of these soils are cultivated. Crops respond well to irrigation, but internal drainage is needed because of the moderately high water table. These soils are suited to all crops commonly grown in the county. Some areas are in native grass. The soils also are suited to trees that can tolerate wetness.

In this county Lex soils are mapped only in an undifferentiated group with Alda soils.

Representative profile of Lex silt loam in an area of Lex and Alda soils, 100 feet north and 25 feet east of the southwest corner of sec. 5, T. 8 N., R. 12 W.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; slightly hard, very friable; mildly alkaline; abrupt, smooth boundary.

A12—5 to 9 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to weak, medium, granular; slightly hard, very friable; mildly alkaline; clear, smooth boundary.

AC—9 to 18 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky; slightly hard, very friable; violent effervescence; moderately alkaline; clear, smooth boundary.

C1—18 to 22 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; common, medium, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure parting to single grained; soft, very friable; slight effervescence; moderately alkaline; gradual, wavy boundary.

IIC2—22 to 60 inches, light-gray (10YR 7/2) coarse sand and gravel, light brownish gray (10YR 6/2) moist; few, fine, faint, yellowish-brown (10YR 5/4) mottles; single grained; loose; mildly alkaline.

The A horizon is 8 to 14 inches thick. Its colors range from dark gray to grayish brown, and its texture is silt loam, loam, or very fine sandy loam. The AC horizon ranges from 7 to 12 inches in thickness and from dark gray to pale brown in color. This horizon is silt loam or loam that is stratified with sandy clay loam to sand in places. Accumulations of free lime and lime concretions are common in the AC horizon. The C horizon ranges from fine sandy loam to loamy sand and grades to coarse sand and gravel at a depth of 20 to 40 inches. Lime is at or near the surface.

Lex soils are near Platte and Alda soils. They are deeper over coarse sand and gravel than Platte soils. Lex soils have a finer textured AC horizon than Alda soils, and they typically have a finer textured C1 horizon than those soils.

Lex and Alda soils (0 to 1 percent slopes) (LA).—This undifferentiated group is on bottom lands along the Platte River. Most areas are about 75 percent Lex silt loam and 25 percent Alda loam, but a few are nearly all Lex soils. Lex and Alda soils in this mapping unit have the profiles described as representative for their respective series. Included in mapping were a few small areas of Platte soils.

In winter capillary action sometimes brings soluble salts to the surface, where they accumulate as a white crust. These salts tend to be leached out and washed away by summer rains and irrigation water, and they seem to

cause little or no damage to growing crops. The soils dry out and warm up slowly in spring, and this delays planting. The water table causes excessive wetness in some years, but in dry years it provides subirrigation. Surface runoff is slow. These soils are seldom flooded.

Nearly all the acreage of these soils is cultivated, and much of it is irrigated. Wheat and grain sorghum are the main dryfarmed crops. Corn and grain sorghum are irrigated. Capability units IIw-4, dryland, and IIw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Marsh

Marsh (M) consists of wet, periodically flooded areas that are in upland depressions (fig. 14). These areas are waterlogged for most of the growing season, and they are often covered with as much as 6 to 12 inches of water. The vegetation consists mainly of cattails, bulrushes, spikerushes, arrowheads, and other marsh-type plants. Between 25 and 75 percent of the acreage is covered by vegetation, and the rest is covered by open water, except in extended dry periods.

The soil material in the Marsh areas is mostly silty clay or clay about 3 to 5 feet thick. It is underlain by loess of silt loam texture.

This land type is associated with Fillmore and Scott soils, which are better drained. Marsh occupies the lowest and wettest part of the depressions.

Marsh is better suited to the production and protection of wetland wildlife than to most other uses. It is too wet for farming, grazing, or growing trees. Capability unit VIIIw-1, dryland; range site not assigned; Undesirable windbreak suitability group.

Meadin Series

The Meadin series consists of shallow, excessively drained soils that formed in recent loamy and sandy alluvium deposited less than 20 inches thick over coarse sand and gravel (fig. 15). These are nearly level to gently sloping soils on stream terraces in the valley along the Platte River.

Figure 14.—Typical area of Marsh in an upland depression. This is excellent habitat for wetland wildlife.

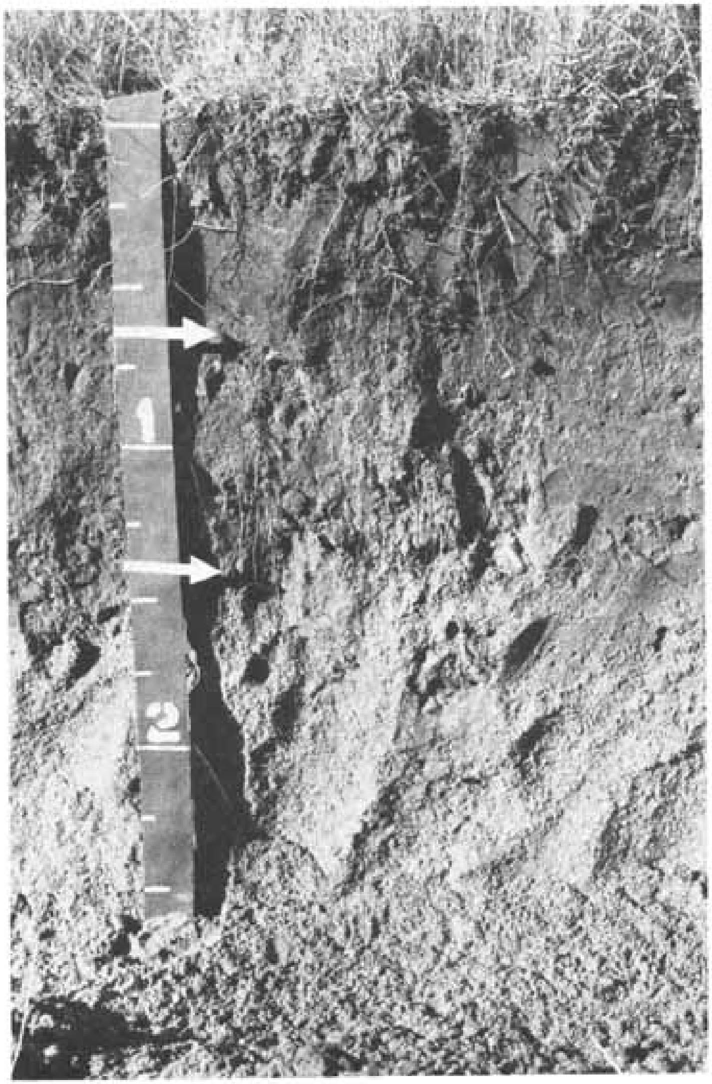


Figure 15.—Profile of Meadin sandy loam. Mixed coarse sand and gravel is at a depth of about 17 inches. Pointers indicate lower boundaries of surface layer and underlying material.

In a representative profile the surface layer is dark-gray sandy loam about 5 inches thick. Next is a transitional layer of grayish-brown loamy sand about 4 inches thick. It is loose when dry and very friable when moist. The underlying material is brown sand that grades to light-gray coarse sand and gravel at a depth of about 14 inches.

Meadin soils have rapid permeability above the underlying coarse sand and gravel and very rapid permeability in the coarse sand and gravel. Available water capacity is low. Organic-matter content and natural fertility are low.

Most of the acreage is in native grass. These soils are droughty and are not suited to cultivated crops if they are dryfarmed. The soils are suited to trees, but suitable species are limited because of the shallow root zone.

Representative profile of Meadin sandy loam, 0.3 mile east and 200 feet south of the northwest corner of sec. 18, T. 8 N., R. 12 W.:

A—0 to 5 inches, dark-gray (10YR 4/1) sandy loam, very dark brown (10YR 2/2) moist; weak, fine, crumb

structure; soft, very friable; neutral; clear, smooth boundary.

AC—5 to 9 inches, grayish-brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure parting to single grained; loose, very friable; neutral; clear, smooth boundary.

C1—9 to 14 inches, brown (10YR 5/3) sand, dark brown (10YR 4/3) moist; single grained; loose; neutral; clear, smooth boundary.

IIC2—14 to 60 inches, light-gray (10YR 7/2) coarse sand and gravel, light brownish gray (10YR 6/2) moist; single grained; loose; neutral.

The A horizon is 5 to 7 inches thick and is dark gray to grayish brown. Its texture is mostly sandy loam or fine sandy loam, but loamy fine sand and silt loam are common. The AC horizon ranges from grayish brown to pale brown and is sandy loam to loamy sand. The C1 horizon ranges from brown to pale brown in color and from loamy fine sand to sand. Coarse sand and gravel are at a depth of 10 to 20 inches. Pebbles are on the surface and are scattered throughout the profile.

Meadin soils are near Anselmo and Thurman soils. They are shallow to mixed sand and gravel, and this is in contrast to the deep Anselmo and Thurman soils.

Meadin sandy loam (0 to 3 percent slopes) (Ms).—This soil is on low, hummocky stream terraces. Included with it in mapping were small areas of soils that have coarse sand and gravel at a depth of 20 to 40 inches and some areas of soils that have a surface layer of silt loam to loamy fine sand.

This soil is better suited to native grass than to cultivated crops. Some areas formerly were cultivated, but they have been reseeded to native grasses. Capability unit VIs-4, dryland; Shallow to Gravel range site; Shallow windbreak suitability group.

Platte Series

The Platte series consists of shallow, somewhat poorly drained soils on the bottom lands along the Platte River. These soils are nearly level to gently sloping. They formed in recent alluvium less than 20 inches thick over coarse sand and gravel. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile the surface layer is dark-gray, calcareous loam about 8 inches thick. The underlying material is light-gray, calcareous very fine sandy loam that is mottled with yellowish brown. It grades to light-gray coarse sand and gravel at a depth of 16 inches.

Platte soils have moderate permeability above the underlying coarse sand and gravel and very rapid permeability in the coarse sand and gravel. They are moderately low in organic-matter content and are medium to low in natural fertility. Platte soils have a low available water capacity. Some areas are subject to infrequent flooding.

These soils are mostly in native grass. Under dryland management they are droughty and are not suited to cultivated crops. They are suited to irrigated crops, but because of the moderately high water table, adequate internal drainage is needed. These soils are suited to trees, but suitable species are limited because of the high water table and shallow root zone. The soils are used by wildlife as a source of food and habitat.

Representative profile of Platte loam, 0.25 mile west and 0.2 mile north of southeast corner of sec. 6, T. 8 N., R. 12 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

A12—5 to 8 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.

C1—8 to 16 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; faint yellowish-brown mottles; massive; soft, very friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

IIC2—16 to 20 inches, light-gray (10YR 7/2) coarse sand and gravel, light brownish gray (10YR 6/2) moist; single grained; loose; mildly alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from dark gray to grayish brown in color. The C and IIC2 horizons range from light brownish gray to very pale brown. Texture of the C1 horizon ranges from loam to sandy loam. Coarse sand and gravel are at a depth of 10 to 20 inches. Pebbles are scattered throughout the profile. Free lime is at a depth of less than 10 inches.

Platte soils are near Lex and Alda soils. Coarse sand and gravel are closer to the surface in Platte soils than in Lex or Alda soils.

Platte loam (0 to 3 percent slopes) (Pt).—This soil is on bottom lands along the South Channel of the Platte River. Included in mapping were small areas of soils that have less than 10 inches of alluvium deposited over coarse sand and gravel. Also included are areas where loamy sand to fine sand is directly below the surface layer.

Surface runoff is slow. Numerous, shallow, intermittent drainageways cross areas of this soil. Many of these drainageways are scars left by former channels of the Platte River. In cultivated areas most of the drainageways have been filled by leveling.

Capillary action brings some soluble salts to the surface in winter, where they accumulate as a white crust. Spring and summer rains tend to leach these salts away, and there is little or no damage to growing crops from the salts. Wetness is a concern in some years, but the water table provides subirrigation in dry years. This soil is slow to dry out and warm up in spring, and this delays spring planting in some years.

About 70 percent of the acreage is in native grass that is grazed or cut for hay. Where dryfarmed, this soil is droughty. Most of the cultivated areas are irrigated. Capability units VIw-4, dryland, and IVw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Riverwash

Riverwash (Rw) is adjacent to the South Channel of the Platte River. It consists of mixed alluvium, 2 to 10 inches thick, over coarse sand and gravel. The surface layer ranges from sand to silty clay loam in texture, but sand is the most common. The water table is at a depth of 12 to 18 inches during most years. Riverwash is subject to flooding.

This land type supports a good growth of trees, shrubs, and some native grasses. About half of the vegetation is woody. Reedgrasses, marsh grasses, and cattails are common.

Areas of Riverwash are used for whatever grazing they will provide. They are excellent habitat for wildlife. Capability unit VIIIs-1, dryland; range site not assigned; Undesirable windbreak suitability group.

Rough Broken Land, Loess

Rough broken land, loess (31 to 100 percent slopes) (RB) consists of very steep areas of loess. These areas occur on the sides of upland drainageways and as escarpments along major streams. They are characterized by soil slips or catsteps, and exposed loess makes up 15 to 50 percent of their surface. In some places there is a thin, slightly darkened surface layer that is calcareous. The underlying material is silty, calcareous loess.

Included with this land type in mapping were areas of steep Coly and Geary soils. Also included were some nearly vertical escarpments that have little or no vegetation.

Most areas of this land type are in native grass. Some small areas support trees and shrubs and are better suited to wildlife than to most other uses. Areas that can be used for grazing are steep and rough and make rather poor grazing land. Capability unit VIIe-1, dryland; Thin Loess range site; Undesirable windbreak suitability group.

Rusco Series

The Rusco series consists of deep, moderately well drained to somewhat poorly drained soils that formed in loess. These are nearly level soils in low swales or basin areas on uplands. They receive runoff from the adjacent uplands, and water ponds in some areas for short periods.

In a representative profile the surface layer is gray silt loam about 8 inches thick. The subsoil is about 12 inches thick. It is grayish-brown silty clay loam in the upper part and light brownish-gray light silty clay loam in the lower part. The subsoil is slightly hard when dry and friable when moist. The underlying material is pale-brown silt loam that has reddish-brown stains.

Rusco soils have moderately slow permeability. Organic-matter content is moderate, and natural fertility is medium to low. Available water capacity is high.

Most areas of Rusco soils are cultivated. The lack of adequate surface drainage can result in crop damage or loss, but crops benefit from the additional moisture in dry years. Crops respond well to irrigation and fertilizer. Some areas are in native grass. Wetness limits the species of trees that can grow on these soils.

Representative profile of Rusco silt loam, 0.25 mile east and 50 feet south of the northwest corner of sec. 4, T. 7 N., R. 12 W.:

Ap—0 to 5 inches, gray (10YR 5/1) silt loam; very dark gray (10YR 3/1) moist; weak, fine, crumb structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—5 to 8 inches, gray (10YR 5/1) silt loam; very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, medium, granular; soft, very friable; neutral; abrupt, smooth boundary.

B2t—8 to 14 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

B3—14 to 20 inches, light brownish-gray (10YR 6/2) light silty clay loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

C—20 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure; soft, very friable; reddish-brown stains; neutral.

The solum ranges from 20 to 30 inches in thickness. The A horizon ranges from 8 to 14 inches in thickness and from dark gray to grayish brown in color. The B horizon is 8 to 16 inches thick and is grayish brown to pale brown. Clay content of the B horizon ranges from 28 to 35 percent. The C horizon ranges from light brownish gray to very pale brown. The lower part of the C horizon is calcareous in some places.

Rusco soils are near Kenesaw and Holder soils. Rusco soils are more poorly drained and have a thinner B horizon than Holder soils. They have a B horizon, which is lacking in Kenesaw soils.

Rusco silt loam (0 to 1 percent slopes) (Ru).—This soil is in small basins or swales within larger areas of hummocky Kenesaw soils. Included in mapping were areas of soils that have a surface layer of silty clay loam, areas in which the subsoil is silt loam, and areas where the underlying material is calcareous.

Surface runoff is slow. Water ponds for short periods in areas where surface drainage is lacking.

Most areas of this soil are cultivated. Grain sorghum is the principal dryfarmed crop. Wheat and alfalfa are grown, but there is a risk of crop damage from flooding in some areas. In most irrigated areas the soil has been leveled and wetness has been eliminated. Corn and grain sorghum are the main irrigated crops. Capability units IIw-31, dryland, and I-3, irrigated; Silty Overflow range site; Moderately Wet windbreak suitability group.

Scott Series

The Scott series consists of deep, poorly drained soils that formed in calcareous loess. These soils are nearly level and occupy the lowest parts of some upland depressions. They are ponded by runoff from adjacent areas.

In a representative profile the surface layer is gray silt loam about 4 inches thick. The subsurface layer is light-gray silt loam about 2 inches thick. The subsoil, which extends to a depth of 45 inches, is dark-gray silty clay in the upper part, gray silty clay in the middle part, and grayish-brown silty clay loam in the lower part. It is very hard when dry and very firm when moist. The underlying material is light brownish-gray silt loam. Lime is at a depth of 45 inches.

Scott soils have very slow permeability and are frequently ponded. Runoff from adjacent areas remains on the surface until it evaporates or is absorbed by the soil. Available water capacity is high, but these soils absorb water slowly. Organic-matter content is moderate, and natural fertility is medium. In wet years these soils are covered by water much of the time.

Scott soils are not well suited to cultivation. They are poor for range and are undesirable for trees, but the vegetation provides good food and cover for wildlife. These areas furnish excellent sites for certain kinds of recreation, such as hunting wildfowl.

Representative profile of Scott silt loam, 0.3 mile west and 100 feet south of the northeast corner of sec. 15, T. 8 N., R. 9 W.:

A1—0 to 4 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; moderate, medium and fine, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

A2—4 to 6 inches, light-gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak, medium and fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

B21t—6 to 27 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong, fine, angular blocky structure; very hard, very firm; numerous, small, black concretions; neutral; gradual, smooth boundary.

B22t—27 to 38 inches, gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; strong, medium, angular blocky structure; very hard, very firm; numerous, small, black concretions; mildly alkaline; gradual, smooth boundary.

B3—38 to 45 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; hard, firm; mildly alkaline; gradual, smooth boundary.

C—45 to 60 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline.

The solum ranges from 36 to 49 inches in thickness. The A1 horizon ranges from 3 to 5 inches in thickness and from dark gray to gray in color. The A2 horizon is 1 to 2 inches thick and is gray to light gray. Its structure is granular or platy. The B horizon ranges from 30 to 42 inches in thickness. The B2t horizon is silty clay or clay and has a clay content of 40 to 55 percent. The C horizon is light brownish gray to pale brown. It has subangular blocky or prismatic structure or is massive. It is stained in some places. Lime is below a depth of 36 inches.

Scott soils are near Butler and Fillmore soils. They are more poorly drained and have a thinner A1 horizon than Butler soils. Scott soils have thinner A1 and A2 horizons than Fillmore soils and are ponded more frequently and for longer periods than those soils.

Scott silt loam (0 to 1 percent slopes) (Sc).—This soil is in oval depressions or basins.

Included with it in mapping were areas of soils that lack a distinct subsurface layer. Also included were a few small areas of Marsh.

Excess water is ponded on the surface until it evaporates or is absorbed by the soil. Unless crops are protected by dikes or diversion terraces, they ordinarily are drowned out in years when rainfall is above normal. Where the claypan subsoil is within 6 inches of the surface, this soil is difficult to work.

Most areas of this soil are used for pasture. Some fringe areas are farmed, but there is a risk of crop damage or loss in most years. Grain sorghum is the crop most commonly grown. Uncultivated areas are covered mostly by low-quality grasses, weeds, and aquatic plants. Capability unit IVw–2, dryland; range site not assigned; Undesirable windbreak suitability group.

Silty Alluvial Land

Silty alluvial land (0 to 1 percent slopes) (Sy) is on bottom lands along major streams and intermittent drainageways. Many areas are bordered by short, steep streambanks or breaks. The soil material consists mainly of deep, stratified, loamy sediments that were washed from the surrounding uplands. These areas are frequently flooded by heavy rains. Where this land type occurs along Sand Creek, sandy material is at a depth below 10 inches. Included in mapping were small areas of Hobbs soils.

The vegetation consists mainly of scattered trees or shrubs and a fair cover of grasses. Some areas are covered by tall weeds. Most areas are used for grazing. The land type is not suitable for cultivation, because most of the areas are small, irregular in shape, and subject to severe flooding. Capability unit VIw–1, dryland; Silty Overflow range site; Undesirable windbreak suitability group.

Spoil Banks

Spoil banks (S) consist of light-colored, loamy soil material along an unused canal that was dug in the uplands northwest of Kenesaw. This land type includes spoil banks that are 10 to 20 feet high along both sides of the canal and also the side slopes and bottom of the canal.

Most areas of Spoil banks are vegetated. The plants consist mainly of a few scattered trees and shrubs and a fair stand of grasses. Much of the acreage is covered with weeds. A few areas are used for grazing. The waste areas provide provide good food and cover for wildlife. Capability unit VIIe–1, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Thurman Series

The Thurman series consists of deep, somewhat excessively drained soils that formed in wind-deposited sandy alluvium that has been reworked by wind. These soils are mainly on stream terraces in the valley of the Platte River and along Sand and Cottonwood Creeks. Slopes range from 0 to 5 percent. Most areas are hummocky.

In a representative profile the surface layer is dark-gray loamy fine sand about 10 inches thick. Next is a transitional layer of light brownish-gray, loose loamy fine sand about 8 inches thick. The underlying material is very pale brown loamy fine sand.

Thurman soils have rapid permeability. Available water capacity is low. Organic-matter content and natural fertility are low.

Most of the acreage of these soils is in native grass and is used for grazing. These soils are suitable for cultivation, but careful management is needed to maintain a good plant cover. The soils tend to be droughty and are subject to severe soil blowing if they are cultivated and left unprotected. They are suited to trees and to use by wildlife.

In this county Thurman soils are mapped only in a complex with Valentine soils.

Representative profile of Thurman loamy fine sand in an area of Thurman-Valentine loamy fine sands, undulating, 0.3 mile north and 200 feet east of the southwest corner of sec. 2, T. 8 N., R. 12 W.:

A—0 to 10 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, crumb; loose, very friable; neutral; clear, smooth boundary.

AC—10 to 18 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure parting to single grained; loose; neutral; gradual, smooth boundary.

C—18 to 60 inches, very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; stratified with fine sandy loam and fine sand; weak, coarse, subangular blocky structure parting to single grained; loose; neutral.

The solum ranges from 15 to 28 inches in thickness. The A horizon ranges from 10 to 14 inches in thickness and from dark gray to grayish brown in color. The color and texture

of the AC horizon range between those of the A and C horizons. The C horizon is loamy fine sand to find sand and is pale brown to very pale brown. Loamy layers and buried soils are common at a depth below 24 inches. Many profiles are stratified with textures ranging from fine sandy loam to sand. Lime and pebbles are in the lower parts of some profiles.

Thurman soils are near Valentine and Anselmo soils. They have a thicker A horizon than Valentine soils, and they are coarser textured than Anselmo soils.

Thurman-Valentine loamy fine sands, undulating (0 to 5 percent slopes) (TxB).—Areas of this complex are hummocky. About 60 percent of the complex is Thurman soil, and 40 percent is Valentine soil. The Thurman soil in this complex has the profile described as representative for its series.

Included in mapping were areas where the surface layer is loamy sand or fine sand. Soil blowing has removed the original surface layer from the crests of some hummocks. The blown sand has accumulated in the low-lying areas between the hummocks.

Surface runoff is slow because most of the rainfall is absorbed as rapidly as it falls. Soil blowing is a severe hazard, and cultivated areas are unstable during periods of high winds.

About 40 percent of the acreage of these soils is cultivated. None of it is irrigated. Corn and grain sorghum are the most common crops. Some wheat and alfalfa are grown. In some areas cultivation has been discontinued and the acreage has been seeded to native grasses or left idle. The rest of the areas are in native grass. Capability unit IVe–5, dryland; Sandy range site; Sandy windbreak suitability group.

Valentine Series

The Valentine series consists of deep, excessively drained soils that formed in wind-deposited sand (fig. 16). Slopes range from 0 to 17 percent but are dominantly not more than 10 percent. The soils are hummocky.

In a representative profile the surface layer is grayish-brown loamy fine sand about 5 inches thick. Next is a transitional layer of grayish-brown, loose fine sand about 7 inches thick. The underlying material is pale-brown fine sand.

Valentine soils have rapid permeability. Available water capacity is low. Organic-matter content and natural fertility are low.

These soils are mostly in native grass. They are not suited to cultivated crops. They are suited to trees and as a source of food and habitat for wildlife.

Representative profile of Valentine loamy fine sand, rolling, 75 feet west and 125 feet north of the southeast corner of sec. 19, T. 6 N., R. 12 W.:

A—0 to 5 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

AC—5 to 12 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure parting to single grained; loose; neutral; gradual, smooth boundary.

C—12 to 60 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure parting to single grained; loose; neutral.

The solum ranges from 5 to 17 inches in thickness. The A horizon ranges from 4 to 8 inches in thickness and from grayish brown to light brownish gray in color. The AC horizon is loamy fine sand to fine sand and is grayish brown to pale brown. The C horizon ranges from loamy sand to fine sand. Its color is brown to very pale brown.

Valentine soils are near Inavale and Thurman soils. They are not so stratified as Inavale soils. They have a thinner A horizon than Thurman soils.

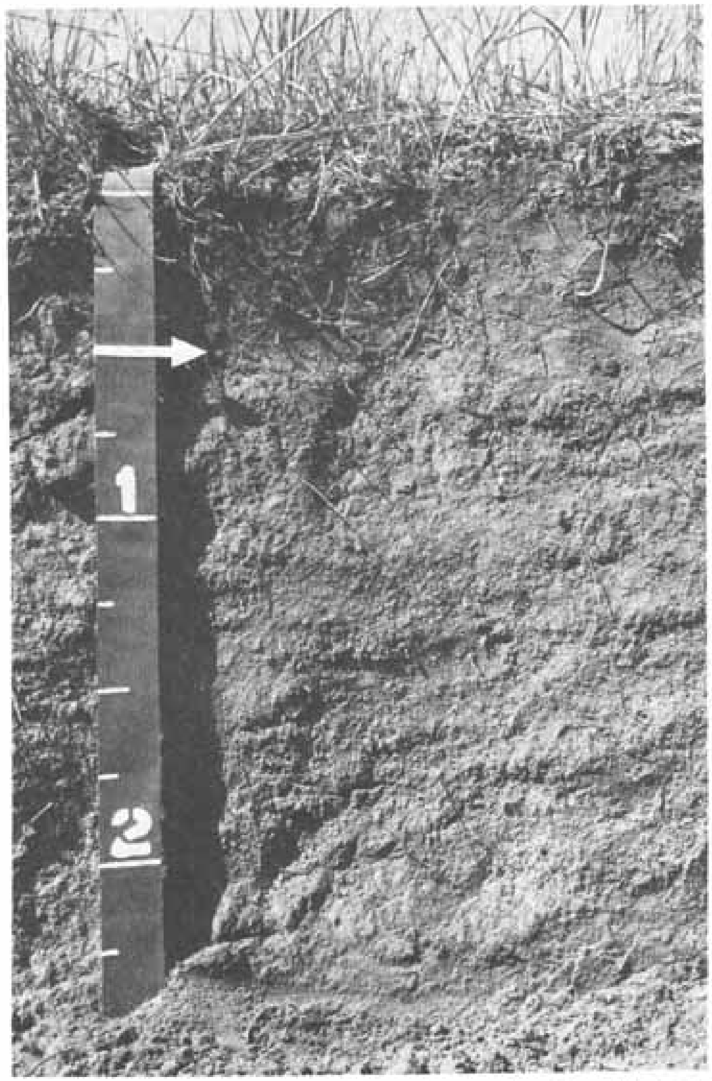


Figure 16.—**Profile of Valentine loamy fine sand, rolling. The thin, granular surface layer is underlain by fine sand at a depth of about 6 inches. Pointer indicates lower boundary of surface layer.**

Valentine loamy fine sand, rolling (3 to 17 percent slopes) (VbC).—This soil is in the sandhill areas of the county. Included in mapping were a few areas of soils that have a surface layer of fine sandy loam. As much as 15 percent of some areas mapped consists of Thurman soils. Small exposures of silty loess material are common.

Surface runoff is slow to very slow because rainfall enters the soil as rapidly as it falls. Soil blowing is a hazard if the grass cover is destroyed.

This soil is used mostly for native grass. It produces a good stand of native grass and is considered to be good grazing land if it is properly managed (fig. 17). Small blowouts are common.

Figure 17.—**Area of Valentine loamy fine sand, rolling. This area is in native grass and has hummocky or dunelike topography that is typical of sandhill areas of the county.**

Because erosion is a severe hazard, this soil is not suited to cultivated crops. Capability unit VIe-5, dryland; Sands range site; Very Sandy windbreak suitability group.

Use and Management of the Soils

This section discusses the use and management of soils for crops and gives predicted yields of the principal crops. It also gives facts about use of the soils for range, for woodland and windbreaks, and for wildlife habitat and recreation. In addition, engineering uses of the soil are discussed.

Management of the Soils for Crops [2]

The main concerns in managing the soils in Adams County are erosion of sloping soils by water; flooding of soils that are adjacent to streams and drainageways and in depressional areas; loss of fertility through the removal of soil material; and soil blowing of exposed soils. Most of the soils in Adams County are suited to crops. Soils that are unsuited to crops are those that have steep slopes; the sandy soils of the Valentine series; the shallow, gravelly soils of the Meadin series; and the land types, Marsh; Riverwash; Rough broken land, loess; Silty alluvial land; and Spoil banks.

All the soils and land types, except Spoil banks, Riverwash, and Marsh, are suited to pasture, range, and trees in windbreaks. All soils and land types are suited to use by wildlife or for recreation.

Cultivated land in Adams County occupies 78 percent of the total land area in the county. According to the 1969 Nebraska Agricultural Census, 91,900 acres of cropland were irrigated.

Corn and grain sorghums are the principal irrigated crops, and wheat, grain sorghums, and alfalfa are the principal dryfarmed crops. Other crops grown on small acreages are oats, rye, soybeans, and tame hay. Each year a part of the cropland is not planted to any crop, but is summer fallowed, used for temporary pasture, or used for soil-improvement grasses or legumes.

Water erosion can be controlled by use of terraces, contour farming, land leveling, contour bench leveling, and grassed waterways. These practices are suited to such soils as Holder silt loam, 3 to 7 percent slopes. They are mostly mechanical, and are most effective if used in combination with other good practices of soil management. By keeping crop residue on the surface or by growing a protective cover of plants, the soil can be kept from sealing or crusting during intense rains. Tall stubble, left over winter to catch drifting snow, can aid in replenishing soil moisture on the soils that are used for dryfarmed crops.

The cropping system can be managed so that highly productive soils on which there is little or no hazard of erosion can be used for row crops and the steeper, more erodible soils can be used for hay and pasture. This will be of benefit in reducing soil losses.

Soil blowing on the Anselmo, Hersh, Inavale, Thurman, Valentine, and similar soils can be reduced by protecting the soil from the action of the wind. Stubble-mulch tillage for small grain, mulch planting for row crops, and using narrow fields of alternating row crops and small grain crops help to reduce wind velocity on the soil surface and thus reduce the movement of soil particles by wind action.

Managing tillage operations during seedbed preparation so as to eliminate all but the essential ones, and using tillage equipment that leaves maximum crop residue on the surface, are of benefit in improving the physical condition of the soil, reducing soil losses, and lessening compaction of the soil.

To sustain their fertility, all soils used for crops and pasture in Adams County need to be tested to determine the need for commercial fertilizer. Fertilizer applications should be based on results of soil tests, along with a consideration of the supply of soil moisture in dryfarmed areas. Where the subsoil is dry and rainfall is low, fertilizer should be applied at a slightly lower rate than that generally used where moisture is favorable. Nitrogen fertilizer results in an increased vegetative growth on all soils in Adams County. Phosphorus and zinc are commonly needed on the eroded upland soils of the Coly, Geary, and Holder series. Phosphorus is needed on the calcareous, somewhat poorly drained soils of the Lex and Alda series. Irrigated soils require a large amount of fertilizer because greater plant growth is more likely on such soils.

Not all the soils in Adams County that are suited to crops are suitable for irrigation. The steeper Coly, Geary, and Holder soils are better used for dryfarming or for pasture or rangeland.

Irrigation water can be applied by the gravity system or by the sprinkler system. Gravity systems distribute water by the furrow, border, or corrugation methods.

[2] By ERVIN O. PETERSON, conservation agronomist, Soil Conservation Service.

Row crops are irrigated by the furrow method, and small grain, hay, and pasture by the border and corrugation methods.

Distributing water through a sprinkler system is suited to all soils that are suitable for irrigation. Several types of sprinklers are used, including those that are self-propelled. These require only a small amount of labor.

Methods of controlling water erosion are necessary on sloping soils that are irrigated. Land leveling to reduce slopes, contour irrigation combined with bench leveling, and terracing on the steeper slopes are methods of reducing erosion if a gravity system is used. Soil losses on soils that are sprinkler irrigated can be controlled by using terraces, contour farming, and grassed waterways. Application rates of irrigation water should be adjusted to match the intake rate of the soils.

Management of crop residue to keep the maximum amount of residue on the surface is needed to reduce soil blowing and water erosion and is helpful in increasing the rate of moisture intake.

Runoff of irrigation water and runoff of excess rainwater from irrigated fields can be retained by the use of a constructed irrigation re-use pit. This stored water can be reused in the irrigation system.

Most supplies of irrigation water in Adams County are obtained from deep wells. In January 1970 there were 1,002 irrigation wells. Water for small areas is also supplied by pumping plants along flowing streams, from dams, and from irrigation re-use pits (fig. 18).

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment (7). The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

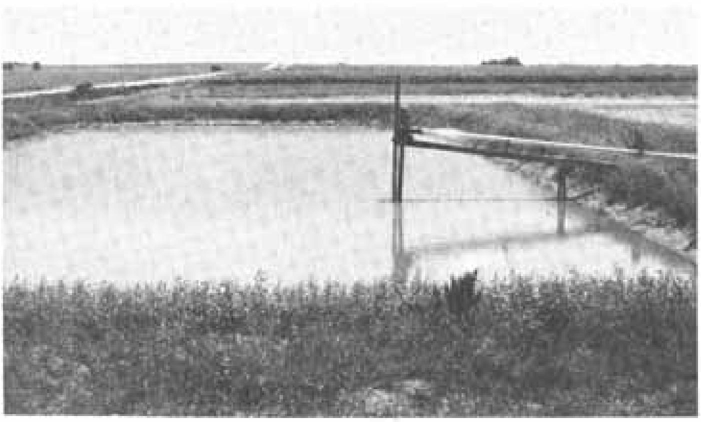


***Figure 18.*—Irrigation re-use pit with centrifugal pump and pipe used to recycle water back into the irrigation system. The soil is Rusco silt loam.**

In the capability system, the kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Adams County.)
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in Adams County but not in all parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many state-

ments about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass. In this survey the Arabic numerals are not consecutive, because not all the capability units in Nebraska are represented in Adams County.

Management by capability units

In the following pages the dryland and irrigated capability units in Adams County are described and suggestions for the use and management of the soils are given. For the names of all the soils in any given unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNITS I-1 DRYLAND AND I-2 IRRIGATED

These units consist of soils in the Cass and Hobbs series that have a medium-textured surface layer and are not flooded. These soils have a medium-textured to moderately coarse textured subsoil. They are nearly level and are well drained, have moderate to moderately rapid permeability, and are moderate to moderately low in organic-matter content. They have moderate to high available water capacity.

The principal concern in management of these soils is maintenance of the organic-matter content and high fertility. Preventing soil blowing in winter is also a concern.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, and alfalfa. Soybeans are grown on a limited acreage. Use of a cropping system that includes management of crop residue and the addition of adequate fertilizer is about all that is needed to maintain these soils for sustained crop production. Keeping a cover of growing plants or organic matter on the surface helps to prevent soil blowing. Diseases and insects can be controlled by using a cropping system that includes row crops in a rotation with small grain, hay, and pasture crops.

Irrigation management.—If these soils are irrigated, they are suited to corn, grain sorghum, alfalfa, and tame grasses. Except where a sprinkler irrigation system is used, slight irregularities in the surface commonly make it difficult to obtain uniform distribution of irrigation water unless the land is leveled. All types of irrigation systems are suited to the soils of this unit. Irrigation water needs to be supplied in sufficient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff.

Crop residue left on the surface during winter aids in the control of soil blowing.

CAPABILITY UNITS IIc-1 DRYLAND AND I-1 IRRIGATED

These units consist of deep, well-drained soils of the Anselmo, Hall, Hastings, Holder, Hord, and Kenesaw series and the Hastings series, thin solum variant. These are nearly level soils on stream terraces and uplands. They have a medium-textured surface layer and a moderately coarse textured to moderately fine textured subsoil. They have moderately rapid to moderately slow permeability and moderate to high available water capacity. These soils generally are high in organic-matter content, but the Anselmo, Hastings, thin solum variant, and Kenesaw soils are moderately low in organic-matter content.

Lack of adequate seasonal rainfall is the main limitation on the soils in these units. Soil blowing is a slight hazard in winter and early in spring (fig. 19).

Dryland management.—Under dryland farming, these soils are better suited to corn, small grain, grain sorghum, and alfalfa than to most other crops. Wheat and grain sorghum are the most dependable crops. Corn and alfalfa are satisfactory in years when moisture is favorable. A cropping system that includes mulch planting, such as stubble-mulch tillage, and summer fallow can be of value in conserving soil moisture.

Irrigation management.—If these soils are irrigated, they are suited to corn, grain sorghum, alfalfa, and tame grasses. All types of irrigation systems are suited. Where a gravity system is used, however, slight irregularities in the surface can make it difficult to secure uniform distribution of irrigation water unless the land is leveled. Crop residue left on the surface in winter helps to control soil blowing. Irrigation water needs to be applied in sufficient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff.

CAPABILITY UNITS IIe-1 DRYLAND AND IIe-1 IRRIGATED

These units consist of deep, well-drained soils of the Hastings, Holder, Hord, and Kenesaw series. These are gently sloping soils on uplands. They have a medium-textured surface layer and a medium-textured to moderately fine textured subsoil. These soils have moderate to moderately slow permeability and high available water capacity. Runoff is slow to medium, and erosion is a hazard in some areas.

Measures to control runoff are needed to reduce erosion and to increase the amount of soil moisture that is available to plants. Soil blowing is a hazard. The maintenance of soil tilth, high fertility, and organic-matter content are needed in cultivated fields.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, soybeans, alfalfa, and hay crops. Runoff can be controlled by use of terraces, contour farming, and grassed waterways.

Figure 19.—Grain sorghum and summer fallow on Hastings silt loam, 0 to 1 percent slopes, in capability unit IIc-1, dryland.

A cropping system that keeps the soil covered with vegetation most of the time helps to reduce moisture loss and soil blowing. Soil fertility can be maintained or increased by the use of commercial fertilizer and barnyard manure.

Irrigation management.—Where these soils are irrigated, the major crops grown are corn and grain sorghum. A smaller acreage of alfalfa is irrigated. For efficient gravity irrigation, the soils need to be leveled to aid in securing an even distribution of irrigation water. Crop residue should be kept on the surface to increase the intake of water and prevent soil blowing. Irrigation runoff water needs to be conserved and controlled at the ends of the fields. Sprinkler systems are suited to these soils (fig. 20).

CAPABILITY UNITS IIe-3 DRYLAND AND IIe-3 IRRIGATED

These units consist of deep, well-drained, nearly level to gently sloping soils of the Anselmo, Cass, Hersh, and Kenesaw series. These soils are on bottom lands and stream terraces. They generally have a moderately coarse textured surface layer and subsoil, but the Kenesaw soils are medium textured throughout the profile. These soils have moderate to moderately rapid permeability and moderate to high available water capacity. The organic-matter content is low or moderately low.

Soil blowing is a hazard on these soils. Conserving moisture and maintaining the organic-matter content and fertility are needed. These soils are somewhat droughty during cycles of low rainfall.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, alfalfa, and hay. Water erosion and soil blowing can be reduced and moisture conserved by use of stripcropping, stubble-mulch tillage, and a cropping system that keeps the soil covered most of the time with growing crops or with crop residue. Where row crops are alternated with small grain and legume crops, fertility is improved and soil blowing is reduced. Soil blowing is also reduced by using machinery that leaves crop residue on the surface as a mulch. Contour farming and terracing can be used to reduce runoff.

Irrigation management.—Where these soils are irrigated, they are well suited to corn, grain sorghum, small grain, and alfalfa. The organic-matter content needs to be kept at a high level through the use of a cropping system that includes small grains and legumes and also by using mulch tillage that leaves crop residue on the soil surface. The sprinkler, furrow, and border methods of irrigation are suited to these soils. The high rate of water intake makes it necessary to limit the length of field runs if row crops are grown and a border irrigation system is used. Reducing and controlling runoff of irrigation water at the ends of fields is needed to help conserve water. Soil blowing can be controlled by keeping a growing crop or organic matter on the soil. For sustained crop production, the optimal use of commercial fertilizer and barnyard manure is needed.

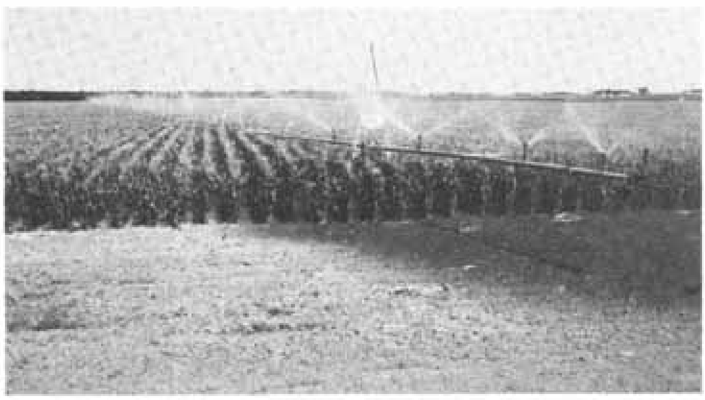


Figure 20.—Center-pivot sprinkler irrigation system applying water to corn growing on Holder silt loam, 1 to 3 percent slopes.

CAPABILITY UNITS IIs-2 DRYLAND AND IIs-2 IRRIGATED

Crete silt loam is the only soil in these units. It is a deep, moderately well drained, nearly level soil on uplands. It has a medium-textured surface layer and a fine-textured subsoil that restricts the penetration of roots and water. This soil has high available water capacity, slow permeability, and moderate organic-matter content.

The main concern in managing this soil is that it is somewhat droughty during dry years. This is because the subsoil absorbs moisture slowly and releases it slowly to plants. Soil blowing can be a hazard if the surface is bare. Fertility needs to be maintained.

Dryland management.—Under dryland farming, this soil is suited to small grain, grain sorghum, corn, and alfalfa. Wheat is the most suitable crop, because it matures before the weather becomes hot and dry. Grain sorghum is better suited than corn. If alfalfa is limited in the cropping system, the supply of moisture in the subsoil is not so rapidly depleted. This soil can be used for the continuous production of row crops if fertility is maintained by the use of commercial fertilizer and the soil is protected from blowing.

Irrigation management.—Where this soil is irrigated, corn, grain sorghum, and alfalfa are better suited than most other crops. Except where sprinkler irrigation is used, some land leveling commonly is necessary to prepare the soil for irrigation. If the subsoil is encountered during land leveling, undercutting and backfilling with 6 inches of topsoil should be considered. Sprinkler, furrow, and border systems of irrigation are suited to this soil. Rates of water application need to be adjusted to correspond to the rate of water intake. Commercial fertilizer or barnyard manure needs to be applied to sustain crop production where irrigated crops are grown.

CAPABILITY UNITS IIw-2 DRYLAND AND IIs-21 IRRIGATED

Butler silt loam is the only soil in these units. This is a deep, somewhat poorly drained, nearly level soil on uplands. It has a medium-textured surface layer and a fine-textured subsoil. Available water capacity is high, and permeability and runoff are slow.

The surface layer of this soil is easily worked and absorbs water readily, but the fine-textured subsoil restricts root development and absorbs water slowly. As a result, the surface layer may stay wet for an extended period of time following rains, particularly in spring. Wetness delays tillage and can retard the growth of crops in some years, but there is seldom a complete loss of crops. This soil is droughty in summer where it is used as dryland.

Dryland management.—Under dryland farming, this soil is suited to small grain, corn, grain sorghum, and

alfalfa. Of these, wheat and grain sorghum are best suited. The wetness can be controlled by installing terraces and diversions in the adjoining higher lying areas to keep runoff away from this soil. Keeping the soil covered with a growing crop or with crop residue helps to control soil blowing.

Irrigation management.—Where this soil is irrigated, it is suited to corn, grain sorghum, and alfalfa. It is also suited to the production of small grain and grasses. Including alfalfa in the cropping system helps to open the subsoil and thus aids the movement of water through the soil. The slow intake of water makes long periods of irrigation necessary. Water management that controls and reduces excessive runoff of irrigation water is needed on this soil. Sprinkler, furrow, and border systems of irrigation are suited to this soil.

CAPABILITY UNITS IIw-3 DRYLAND AND IIw-3 IRRIGATED

These units consist of deep, well-drained soils of the Cass and Hobbs series. These are nearly level to gently sloping soils on bottom lands that are occasionally flooded. They have a medium-textured to coarse-textured surface layer and a medium-textured to moderately coarse textured subsoil. Permeability is moderate to moderately rapid. Available water capacity is moderate to high. The organic-matter content is moderate to moderately low, and fertility ranges from high to medium.

Because these soils are flooded occasionally for short periods, crops can be damaged by scouring, standing water, or sedimentation. In dry years, however, some areas benefit from the extra moisture. Planting, tillage, or harvesting is sometimes delayed because of wetness.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, alfalfa, and grasses. Occasional flooding in spring can limit production of small grain and alfalfa. In dry years, occasional flooding of minor extent is beneficial to row crops because it adds to the moisture supply. In most areas drainage ditches and diversions can be used to move floodwater off the soils. Management that keeps drainage ditches and diversions clear of obstructions is needed so that the structures can intercept and divert the floodwater as intended.

Irrigation management.—If these soils are irrigated, they are better suited to corn and sorghum than to most other crops. Alfalfa, small grain, and grasses are also suited if flooding is controlled. Both sprinkler and gravity systems of irrigation are suited to the soils of this unit. An irrigation system that provides for the diversion or interception of floodwater is needed. Furrow and border systems of irrigation should be accompanied by land leveling that provides surface drainage and even distribution of irrigation water. Management that reduces or controls irrigation runoff at the ends of fields is also necessary.

Use of adequate commercial fertilizer helps to maintain fertility, and mulch tillage is needed to help protect these soils when irrigated crops are grown.

CAPABILITY UNITS IIw-31 DRYLAND AND I-3 IRRIGATED

The only soil in these units is Rusco silt loam. This is a deep, moderately well drained to somewhat poorly drained soil. It is nearly level and is in run-in areas or swales on uplands. It has a medium-textured surface layer and a moderately fine textured subsoil. Permeability is moderately slow, and available water capacity is high. The organic-matter content is moderate, and fertility is medium to low.

This soil is flooded occasionally for short periods. Crops are occasionally damaged by standing water, but in dry years some areas benefit from the extra moisture. Planting, tillage, or harvesting is sometimes delayed because of wetness.

Dryland management.—Under dryland farming, this soil is suited to corn, grain sorghum, small grain, alfalfa, and grasses. Occasional flooding in spring limits the growth of small grain and alfalfa crops. In some areas, diversions and drainage ditches can be used to reduce the hazard of flooding by intercepting the runoff and keeping it from spreading over a wide area. Diversions and drainage ditches should be cleaned and maintained to keep them functioning properly.

Irrigation management.—If this soil is irrigated, it is better suited to corn and sorghum than to most other crops. Where flooding is controlled, alfalfa, small grain, and grasses are also suited. An irrigation system that provides for diverting or intercepting the floodwater or runin water is needed on this soil. Furrow and border systems of irrigation are best suited, but a sprinkler system can also be used. Management that reduces or controls irrigation runoff at the ends of fields is necessary. Land leveling helps to provide surface drainage.

The use of adequate commercial fertilizer helps to maintain fertility, and mulch tillage helps to protect this soil when irrigated crops are grown.

CAPABILITY UNITS IIw-4 DRYLAND AND IIw-4 IRRIGATED

These units consist of moderately deep, somewhat poorly drained soils of the Lex and Alda series. These are nearly level soils on bottom lands. They have a medium-textured surface layer and a medium-textured to moderately coarse textured subsoil. They are underlain by coarse sand and gravel at a depth of 20 to 40 inches. These soils have moderate to moderately rapid permeability except in the coarse sand and gravel, where permeability is very rapid. These soils have low available water capacity. They are mildly alkaline to moderately alkaline and are seldom flooded. The water table fluctuates between depths of 2 and 6 feet, and this makes wetness the main limitation. The water table is high enough to limit production in most years, but crops can benefit from the subirrigation in dry years.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, alfalfa, and grasses. Small grain and alfalfa are least suited, because of the high level of ground water in spring. Corn, grain sorghum, and grasses are best suited to these soils. The hazard of wetness and the high water table can be controlled through the use of drainage ditches or tile drains. Lowering the water table aids in the reduction and control of salts that can accumulate on the surface of the soils in spring.

Irrigation management.—If these soils are irrigated, they are suited to the production of corn, grain sorghum, alfalfa, and grasses for hay and pasture. Land leveling is needed for the use of furrow and border irrigation methods and to provide adequate surface drainage. Drainage ditches, tile drains, and diversions can be used to lower the water table. Application of an excessive amount

of water results in leaching of nutrients into the underlying sand and gravel. Legume crops respond to applications of phosphorus. Sprinkler irrigation is suited to these soils.

CAPABILITY UNITS IIIe-1 DRYLAND AND IIIe-1 IRRIGATED

These units consist of deep, well-drained soils of the Geary, Holder, and Kenesaw series. These are moderately sloping soils on uplands. Some areas are hummocky. These soils have a medium-textured surface layer and a medium-textured to moderately fine textured subsoil. They have moderate to moderately slow permeability. Available water capacity is high. The organic-matter content generally is moderate, but in the Kenesaw soils it is moderate to low. Runoff is medium.

Sheet and gully erosion is a hazard where these soils are cultivated and not protected. Some areas of these soils are eroded.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, alfalfa, and grasses. Use of terraces, grassed waterways, contour farming, and a crop-residue mulch can reduce runoff and erosion. Moisture can be conserved and soil blowing controlled through the use of a cropping system that keeps the soil covered with crops or residue most of the time. This also helps to control water erosion. The cropping system used should limit the years of consecutive row crops and include some close-growing crops, such as small grain, alfalfa, and grasses. The use of mulch tillage during seedbed preparation can supplement mechanical practices for controlling erosion. Commercial fertilizer or barnyard manure is commonly needed for maintaining fertility.

Irrigation management.—If these soils are irrigated, they are well suited to alfalfa and grasses. Where erosion control methods are provided, the soils are also suited to corn and grain sorghum. Erosion can be controlled by use of terraces, contour irrigation, waterways, and crop residue on the surface. Soil fertility can be maintained and improved by using manure and commercial fertilizer.

The sprinkler system is the most suitable method of irrigating the soils of this unit. Slope makes it difficult to control water erosion resulting from rainfall and the additional water from irrigation. The rate of applying water needs to be carefully controlled so as not to exceed the intake rate of the soil.

Furrow and border irrigation methods can be used on these soils if land leveling is extensive enough to adjust slopes so that water erosion and runoff are at a minimum. Contour bench leveling is suited to the more gently sloping areas. Management that reduces or controls runoff of irrigation water at the ends of fields is needed.

CAPABILITY UNITS IIIe-3 DRYLAND AND IIIe-3 IRRIGATED

These units consist of deep, well-drained to excessively drained soils of the Hersh and Inavale series. These are nearly level to moderately sloping soils on bottom lands and uplands. Some areas are hummocky. These soils have a moderately coarse textured surface layer and a moderately coarse textured to coarse textured subsoil. Permeability is moderately rapid to rapid. The soils have moderate to low available water capacity. The organic-matter content is low.

Soil blowing is a hazard where these soils are cultivated and the surface is not protected. Water erosion is a hazard on the Hersh soils. The soils on the bottom lands are seldom flooded.

Dryland management—Under dryland farming, the soils in this unit are suited to corn, grain sorghum, small grain, alfalfa, and grasses. Soil blowing and water erosion can be reduced and moisture conserved by using narrow, alternate fields of row crops and small grain, mulch tillage, and a cropping system that keeps the soil covered with residue most of the time. Use of terraces and contour farming on the longer slopes of the Hersh soils helps to control water erosion.

Irrigation management.—If these soils are irrigated, they are suited to corn, small grain, grain sorghum, alfalfa, and tame grasses. The sprinker, furrow, and border systems of irrigation are suitable for use on these soils. A sprinkler system can be used on soils where land leveling is not practical. Where furrow and border systems are used, best management of irrigation water is achieved in fields that have been leveled. Deep cuts for land leveling expose the sandy underlying material. Irrigation water needs to be applied frequently. Excessive applications of water are to be avoided, because leaching of nutrients below plant roots can occur in these soils. Controlling runoff from irrigation is a good way to conserve water. Soil fertility can be maintained and improved through the use of commercial fertilizer and barnyard manure.

CAPABILITY UNITS IIIe-31 DRYLAND AND IIe-31 IRRIGATED

Anselmo fine sandy loam, terrace, 1 to 3 percent slopes, is the only soil in these capability units. This is a deep, well-drained, nearly level to moderately sloping soil on stream terraces. Some areas are hummocky. This soil has a moderately coarse textured surface layer and subsoil. Permeability is moderately rapid, and the available water capacity is moderate. The organic-matter content is moderately low, and fertility is medium.

Soil blowing is a hazard where this soil is cultivated and the surface is not protected.

Dryland management.—Under dryland farming, this soil is suited to corn, grain sorghum, small grain, alfalfa, and grasses. Soil blowing can be reduced and moisture conserved by using narrow, alternate fields of row crops and small grains, mulch tillage, and a cropping system that keeps the soil covered with residue most of the time.

Irrigation management.—If this soil is irrigated, it is suited to corn, small grain, grain sorghum, alfalfa, and tame grasses. Irrigation methods best suited are furrow, border, and sprinkler systems. Sprinklers can be used in areas where land leveling is impractical. Best management of irrigation water in the furrow and border systems is on fields that have been leveled. Deep cuts for land leveling expose the sandy underlying material. Irrigation water needs to be applied frequently, but excessive applications of water leach nutrients below a level where plant roots can obtain them. Controlling runoff from irrigation is a good way to conserve water. Soil fertility can be maintained and improved through the use of commercial fertilizer and barnyard manure.

CAPABILITY UNITS IIIe-5 DRYLAND AND IIIe-5 IRRIGATED

Inavale loamy fine sand is the only soil in these units. This is a deep, nearly level to gently sloping, excessively drained soil on bottom lands. These areas have a low hummocky landscape. The soil is coarse textured in its surface layer and subsoil. It has rapid permeability and low available water capacity. The organic-matter content is low.

Soil blowing is a severe hazard where this soil is cultivated. A few low-lying areas are subject to occasional overflow following heavy rains.

Dryland management.—Under dryland farming, this soil is suited to corn, grain sorghum, small grain, alfalfa, and grasses. Small grain and the first cutting of alfalfa are the most dependable crops because they grow and mature in spring when rainfall is the highest. Soil blowing can be reduced, moisture conserved, and the organic-matter content and fertility maintained through the use of a cropping system that keeps the soil covered with crop residue most of the time. A cropping system is needed that will limit the number of years of successive row crops and include some close-growing grass and legume crops to protect the soil and to conserve moisture. Planting close-growing crops in narrow, alternate strips and using narrow field windbreaks help to control soil blowing.

Irrigation management.—If this soil is irrigated, it is better suited to corn and alfalfa than to most other crops. Small grain, grasses, and legumes can also be grown. Furrow, border, and sprinkler irrigation systems are suited to this soil. Ordinarily, leveling is needed if the furrow and border methods are to be used, but deep cuts for leveling expose the sandy underlying material. Maintenance of cover, consisting either of growing crops or crop residue, is essential to control soil blowing. Applications of irrigation water need to be frequent and light. Excessive application of water causes loss of fertilizer by leaching the nutrients below the depth of crop roots.

Sprinkler systems are well suited to this soil. The rate of water application should be adjusted to prevent excessive runoff in the gently sloping areas.

CAPABILITY UNITS IIIe-8 DRYLAND AND IIIe-11 IRRIGATED

These units consist of the severely eroded soils of the Holder and Geary series. These are moderately sloping soils on uplands. They are moderately fine textured in their surface layer and subsoil. They have moderate to moderately slow permeability and a high available water capacity. The organic-matter content is low. Fertility is low, and runoff is medium.

Water erosion is a severe hazard on these soils. The soils take in water slowly and are difficult to irrigate because of the hazard of erosion. Maintaining fertility is also a concern. Tilth and workability are poor. These soils tend to puddle if they are worked when too wet.

Dryland management.—Under dryland farming, these soils are suited to corn, grain sorghum, small grain, alfalfa, and grasses. Small grain, grasses, and alfalfa are better suited because they are close-growing crops that are more able to resist erosion and do not require cultivation. The use of terraces, grassed waterways, contour farming, and crop residue helps to reduce runoff and erosion. Moisture can be conserved and soil blowing controlled by using a cropping system that keeps the soil covered with crops or crop residue most of the time. This also helps to control water erosion. A cropping system is needed that limits the years of consecutive row crops and includes several years of close-growing crops, grass, and legumes. The use of mulch tillage during seedbed preparation supplements the mechanical practices for controlling erosion. Fertilizer and barnyard manure are needed for proper maintenance of fertility. The hazard of erosion can be greatly reduced by converting the soils to rangeland and using them for grazing.

Irrigation management.—If these soils are irrigated, they are suited to alfalfa and grasses for hay or pasture. Corn and grain sorghum are suited where erosion control methods are provided. Erosion can be controlled by the use of terraces, contour irrigation, waterways, and the maximum amount of crop residue on the surface. Fertility can be maintained by using barnyard manure, green-manure crops, and commercial fertilizer.

The sprinkler system is the most suitable method of irrigating the soils of this unit. The slopes make it difficult to control water erosion resulting from rainfall and the additional water from irrigation. Rates of water application need to be carefully controlled and should be no higher than the intake rate of these soils.

Furrow and border irrigation systems can be used on these soils if land leveling is extensive enough to adjust slopes so that water erosion and runoff are at a minimum. Contour bench leveling is suited to the more gentle slopes.

CAPABILITY UNITS IIIw-2 DRYLAND AND IIs-22 IRRIGATED

Fillmore silt loam is the only soil in these units. This is a deep, nearly level, poorly drained soil in upland depressions. It is occasionally flooded. It has a medium-textured surface layer and a slowly permeable, fine-textured subsoil that restricts penetration of roots and water. Runoff is very slow. This soil has high available water capacity and a moderate content of organic matter.

Crops grown on this soil are commonly damaged or lost by flooding and the lack of surface drainage. In some years, when rainfall is heaviest, this soil is too wet for cultivation.

Dryland management.—Under dryland farming, this soil is suited to small grain, corn, grain sorghum, alfalfa, and grasses. Wheat and grain sorghum are the best suited. Wildlife use these areas for nesting or as a source of food. Cropping systems need to include small grain and legumes. The excessive wetness of this soil can be controlled by installing terraces and diversions in the adjoining, higher lying areas. Keeping the soil covered with a growing crop or with organic matter tends to improve both tilth and fertility.

Irrigation management.—If this soil is irrigated, it is suited to corn, grain sorghum, alfalfa, and grasses. Including alfalfa in the cropping system helps to open the subsoil and thus aids in moving water through the soil. The slow rate of water intake makes longer periods of irrigation necessary. Irrigation water management that controls and reduces excessive water runoff is also needed on this soil. Sprinkler, border, and furrow irrigation systems are all suited. The rate of applying water needs to be adjusted so that it does not exceed the rate of water intake in the soil.

CAPABILITY UNIT IVe-1 DRYLAND

This unit consists of the strongly sloping soils of the Geary and Holder series. These are deep, well-drained soils on uplands. They have a medium-textured surface layer and a moderately fine textured subsoil. Runoff is medium to rapid. These soils have moderate to moderately slow permeability and high available water capacity. Their organic-matter content is moderate.

Sheet and gully erosion is a hazard if these soils are cultivated and the surface is not protected. These soils generally are not well suited to irrigation. The severe hazard of erosion makes it impractical to install the structures needed to control the water and hold soil loss to a minimum when irrigation water is applied.

Alfalfa, grasses, and wheat are better suited to these soils than are most other crops. To aid in controlling erosion, grain sorghum and corn need to be limited in a cropping system that includes small grain, grasses, and alfalfa. Terraces, contour farming, grassed waterways, and the use of crop residue in mulch tillage are additional management practices needed to supplement the cropping system.

The soils in this unit are also suited to pasture, rangeland, windbreaks, wildlife, and recreational uses. The hazard of water erosion can be reduced on rangeland by allowing a part of the yearly growth of grass to remain after the grazing season.

CAPABILITY UNIT IVe-5 DRYLAND

Only Thurman-Valentine loamy fine sands, undulating, are in this unit. These are deep, somewhat excessively drained to excessively drained soils on stream terraces and uplands. They are nearly level to moderately sloping, and most areas are hummocky. These soils have a coarse-textured surface layer and subsoil. Permeability is rapid. Available water capacity is low. The organic-matter content and natural fertility also are low.

In cultivated areas, soil blowing is a severe hazard if these soils are left unprotected. Corn, grain sorghum, small grain, alfalfa, and grasses are suited crops. Small grain and the first cutting of alfalfa generally are the most dependable crops because they grow to maturity in spring when rainfall is highest.

A cropping system that keeps the soil covered with residue most of the time aids in reducing soil blowing. The cropping system needs to limit the number of years in successive row crops and include some close-growing and legume crops to protect the soil and to conserve moisture. Planting alternate, narrow strips of close-growing crops and row crops and using narrow windbreaks of trees help to control soil blowing. Commercial fertilizer and barnyard manure help to improve and to maintain soil fertility.

CAPABILITY UNIT IVe-8 DRYLAND

This unit consists of strongly sloping, deep soils of the Coly, Geary, and Holder series. These are well-drained soils on uplands. They have a medium-textured to moderately fine textured surface layer and subsoil. These soils have moderate to moderately slow permeability and high available water capacity. The organic-matter content and natural fertility are low.

Runoff is medium to rapid, and sheet and gully erosion is a severe hazard. In most areas the original surface layer has been removed by erosion. Tilth generally is poor. Some areas of these soils are difficult to cultivate because of strong slopes and poor workability. In places the soils puddle if worked when wet and are hard when dry.

Alfalfa, grass, and wheat are close-growing crops that are better suited to this soil than are most other crops. Using a cropping system that limits corn and grain sorghum to 1 year and alternating them with small grain, alfalfa, and hay crops can help to reduce erosion. Terraces, contour farming, grassed waterways, and the use of crop residue and mulch tillage are additional practices that aid in checking soil losses.

Soils in this unit are also suited to pasture, rangeland, windbreaks, wildlife, and recreational uses. The hazard of water erosion can be reduced by converting these areas to grassland, pasture, or rangeland. Grassland management that leaves about one-half the yearly growth on the soil after the growing season helps to reduce water erosion.

These soils are not suited to irrigation, because the hazard of erosion is too severe.

CAPABILITY UNIT IVw-2 DRYLAND

Scott silt loam is the only soil in this unit. This is a deep, poorly drained soil in upland depressions that are frequently flooded. This soil has a thin surface layer and a fine-textured subsoil. Permeability is very slow. The subsoil restricts penetration of roots and water. This soil has a high available water capacity.

Wetness during part or all of the year is the main limitation to the use of this soil. Surface drainage is difficult because the depressions have no outlets. Cultivated crops can be grown in some areas in dry years, but crops are damaged or lost by flooding in most years.

Wheat and grain sorghum are better suited to this soil than are most other crops. Corn, alfalfa, and grass can also be grown but are not so well suited. There is a possibility, in some areas, for controlling the excessive wetness by installing terraces and diversions on the adjacent, higher lying soils.

The soil in this unit is also suited to development as wetland for wildlife. Where the adjacent areas are irrigated and runoff is present, this Scott soil is waterlogged during most of the summer and makes valuable wetland for wildlife.

This soil is not suited to irrigation of cultivated crops, because of excessive soil wetness and flooding.

CAPABILITY UNIT VIe-1 DRYLAND

This unit consists of deep, somewhat excessively drained soils in the Geary series and of Breaks-Alluvial land complex. The soils in this unit are steep and are on uplands and along the sides of intermittent drainageways. They have a medium-textured surface layer and a medium-textured or moderately fine textured subsoil. Permeability is moderately slow, the available water capacity is high, and the organic-matter content is low to moderate.

Because of rapid runoff, much of the rainfall is lost and gullies develop easily. Catsteps are common. These soils are not suited to cultivated crops, because they are too steep and too erodible. They are better suited to native grass or hay and to grazing.

Areas of these soils that are cultivated can be seeded to native grass and converted to rangeland. The soils also are

suited to trees in windbreaks and to development for wildlife and recreation.

Seeded areas need proper range management to maintain a good cover of grass. Stock-water dams, erosion control structures, and floodwater detention reservoirs can be built at the bottoms of drainageways.

CAPABILITY UNIT VIe-5 DRYLAND

Valentine loamy fine sand, rolling, is the only soil in this unit. This is a deep, excessively drained soil on uplands where the landscape is hummocky. The slopes range from moderate to steep. This soil has a coarse-textured surface layer and subsoil. Permeability is rapid, available water capacity is low, and organic-matter content and natural fertility are low.

This soil absorbs rainwater almost as rapidly as it falls, and there is little runoff. The soil is subject to severe soil blowing if it is not protected by a permanent cover of grass. Most areas are stabilized with grass, but small blowouts are common.

This soil is not suited to cultivated crops, because it is too coarse textured and too droughty. It is suited to grazing, to growing trees in windbreaks, and to use as a source of food and cover for wildlife. Any areas in cultivation can be reseeded to native grass and converted to range. This soil produces fair to good stands of grass but needs proper range management.

CAPABILITY UNIT VIe-9 DRYLAND

The only soil in this unit is Coly silt loam, 11 to 31 percent slopes. This is a deep, somewhat excessively drained soil on uplands. It is steep and occurs on side slopes of intermittent drainageways. This soil has a thin, medium-textured surface layer and subsoil. Natural fertility and organic-matter content are low. The available water capacity is high, and permeability is moderate.

This soil absorbs water well, but because of rapid runoff, much of the moisture received as rainfall is lost and gullies develop easily. Because the soil is susceptible to water erosion, it is not suitable for cultivation and needs to be left in native grass and used for grazing. Soil slips or catsteps are common. Most areas have lime at or near the surface.

Cultivated areas can be seeded to native grass and thus converted to rangeland. Stockwater dams, erosion control structures, and floodwater detention structures can be built at the bottoms of some drainageways. This soil is also suited to trees in windbreaks and to development of areas for wildlife and recreation.

CAPABILITY UNIT VIs-4 DRYLAND

The only soil in this unit is Meadin sandy loam. This is a shallow, nearly level, excessively drained soil on stream terraces. It formed in coarse-textured alluvial material that is underlain by coarse sand and gravel at a depth of 10 to 20 inches. The soil material has rapid permeability in the upper part and very rapid permeability in the underlying sand and gravel. The available water capacity is low. Organic-matter content and natural fertility also are low.

This soil is droughty. It absorbs water readily, but little can be stored for use by plants.

This soil is suitable for range, and most of the acreage is used for this purpose. It can also be used by wildlife or for recreation. Cultivated areas can be seeded to a mixture of native grasses and thus be converted to rangeland. Grazing needs to be controlled on both native and seeded areas so that at least half of each year's growth is left on the surface as mulch.

CAPABILITY UNIT VIw-1 DRYLAND

This unit consists only of Silty alluvial land, a land type that occurs on bottom lands. It is not suitable for cultivation, because it is frequently flooded. Most areas are cut into small areas by deep, meandering channels. The areas are commonly covered with trees, brush, and weeds, or they support a fair stand of grasses. Some areas are bordered by short, steep banks that are covered with trees.

This land type is better suited to use as rangeland, for growing trees, or for development as wildlife or recreational areas than to most other uses. Nearly all areas are used for rangeland and are grazed by livestock. Proper range management helps to maintain vigor of the grasses. In many areas, grass is sparse because of the many native trees.

Erosion control structures can be built on this land type if care is used in selecting the sites. Large floodwater retention structures help to reduce flooding in areas below the structures.

CAPABILITY UNITS VIw-4 DRYLAND AND IVw-4 IRRIGATED

Platte loam is the only soil in these units. This is a shallow, somewhat poorly drained, nearly level to gently sloping soil on bottom lands. It formed in medium-textured to moderately coarse textured alluvial material that is underlain by coarse sand and gravel at a depth of 10 to 20 inches. Permeability is moderate in the upper part of the soil and very rapid in the underlying coarse sand and gravel. The water table fluctuates between depths of 2 and 6 feet. This soil has a low available water capacity. Organic-matter content is moderately low. The soil is moderately alkaline in the surface layer.

The water table in this soil may cause excessive wetness in some years, but in dry years it provides moisture for subirrigation. Some low-lying areas in channels are subject to occasional flooding in spring.

Dryland management.—Under dryland farming, this soil is better suited to native grasses for hay and grazing than to most other crops. Areas now being cultivated can be returned to rangeland by reseeding with native grasses. Management of grazing and proper cutting of the hay crop are necessary to allow for vigorous growth of grass cover on this soil.

Irrigation management.—If this soil is irrigated, it is suited to corn, grain sorghum, and grasses. This soil is best suited to the sprinkler irrigation system. Among the better suited crops are grasses that are used for hay or pasture. The very rapid permeability of the underlying material and the low available water capacity of this soil make light, frequent applications of irrigation water necessary. Fertilizer and water applications can be light and frequent. Level borders and controlled flooding are systems that can be used, particularly with a grass crop.

CAPABILITY UNIT VIIe-1 DRYLAND

Rough broken land, loess, and Spoil banks are two land types in this unit. The soil material is steep to very steep

and consists of deep, medium-textured material on escarpments along streams, on the sides of drainageways, and in areas adjacent to canals. In some areas, soil material has moved downward in landslips, commonly called catsteps. Raw loess is exposed in many places.

Most areas of these land types are covered with a fair growth of grass, weeds, or trees. Suitability for grazing is limited, but the land types are better suited to this use than to most others. They are also used by wildlife for habitat, as cover, and as a source of food. Management that maintains a good cover of vigorous grass is needed to reduce water erosion and to conserve as much of the moisture as possible.

Stockwater dams and erosion control structures can be built at the bottoms of natural drainageways in areas of Rough broken land, loess.

CAPABILITY UNIT VIIIs-1 DRYLAND

Only Riverwash is in this unit. This land type consists of areas of shallow and very shallow, moderately fine textured to coarse-textured alluvial soil materials that are less than 10 inches thick over the underlying coarse sand and gravel. These areas are stabilized with a fair to poor cover of grasses, trees, and shrubs. A water table is at or near the surface most of the time, and the areas are subject to frequent flooding. Most areas are used for whatever grazing they provide. Riverwash makes excellent habitat for wildlife.

CAPABILITY UNIT VIIIw-1 DRYLAND

In this unit is Marsh, a land type that occurs in depressions on uplands. Water 6 to 12 inches deep covers the surface during most of the year. In most places the water usually is not deep enough to prevent the growth of cattails, rushes, reedgrasses, and other aquatic plants. Open, shallow water covers the remaining acreage. The soil material in these areas is mostly fine textured. Marsh provides excellent areas for nesting and feeding of waterfowl, and this is its principal use. Hunters use the areas for recreational purposes during hunting seasons.

Predicted Yields

Table 2 lists for each soil in the county the predicted average yields per acre of the principal crops grown under two levels of management. The yields are predicted average yields for a 10-year period and are based on observations and comparisons by farmers and agricultural leaders who are familiar with the soils and farming in the county. The yields reflect years when rainfall was above average and years when it was below average. They also take into account the probable losses caused by climatic conditions, insects, and diseases.

The figures in columns A of table 2 represent yields that can be expected under common management. Those in columns B represent yields that can be expected under improved management.

Under common management it is assumed that (1) moderate amounts of fertilizer are used but the nitrogen content of the soil is low; (2) the organic-matter content of the soil is low and soil tilth is not maintained at a high level; (3) more erosion control practices are needed; (4) certified seed is not always used; and (5) weeds, insects, and diseases are not always properly controlled.

Under improved management, it is assumed that (1) fertilizers are applied in quantities indicated by the results of soil tests and field experience; (2) crop residue is returned to the soil to improve tilth and to maintain or increase the organic-matter content; (3) the soils are drained, where necessary, and erosion is controlled; (4) certified seed is used and stands are adequate; (5) weeds, insects, and diseases are effectively controlled; (6) tillage is adequate and timely; and (7) crops are grown in suitable rotations.

Management of the Soils for Range[3]

Rangeland makes up 16 percent of the land area of Adams County. It is in widely scattered areas throughout the county, but it is concentrated to some degree in areas of sandy soils in the western part of the county. Rangeland generally is not suitable for cultivation. The largest area is in the Valentine-Thurman and Hastings-Holder associations.

Raising livestock, mainly cows and calves, and selling calves as feeders in the fall, is the second largest farm enterprise in the county.

Range sites and condition classes

Different kinds of rangeland produce different kinds and amounts of native grass. For proper range management, an operator needs to know the different kinds of soil, or range sites, in his holding and the native plants each site can grow. Management can then be used that will favor the growth of the best forage plants on each kind of soil.

Range sites are distinctive kinds of rangeland that differ from each other in their ability to produce a significantly different kind, proportion, or amount of climax or original vegetation. A significant difference, such as a different stocking rate, is one that is great enough to require some variation in management. *Climax vegetation* is the combination of plants that originally grew on a given site. The most productive combination of range plants on a site is generally the climax type of vegetation.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vegetation. This classification is used for comparing the kind and amount of present vegetation with that which the site can produce. Changes in range condition are caused mainly by the intensity of grazing and by drought.

Climax vegetation can be altered by intensive grazing. Livestock graze selectively. They constantly seek the more palatable and nutritious plant. Plants react to grazing in one of three ways—they decrease, increase, or invade. Decreaser and increaser plants are climax plants. Generally, *decreasers* are the most heavily grazed and, consequently, the first to be injured by overgrazing. *Increasers* withstand grazing better or are less palatable to the livestock. They increase under grazing and replace the decreasers. *Invaders* are weeds that become established after the climax vegetation has been reduced by grazing.

Range condition is expressed in four condition classes to show the present condition of the vegetation on a range site in relation to the vegetation that grew on it originally. The condition is *excellent* if 76 to 100 percent

[3] By PETER N. JENSEN, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal crops*

[Absence of an entry indicates that the soil or land type is not suited to the specific crop, that the crop is grown on only a small acreage, or that irrigation is not practical]

Mapping unit	Grain sorghum				Wheat		Corn				Alfalfa (hay)			
	Dryland		Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	43	65	80	105	24	30	21	32	115	135	1.5	2.0	3.5	4.5
Anselmo fine sandy loam, terrace, 1 to 3 percent slopes	39	62	75	100	20	27	19	31	95	120	1.3	1.9	3.2	4.2
Anselmo loam, terrace, 0 to 1 percent slopes	54	75	100	115	30	35	29	37	125	145	2.0	2.5	4.5	5.5
Breaks-Alluvial land complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Butler silt loam	41	61	95	110	26	33	29	37	110	135	1.3	2.0	3.8	5.0
Cass fine sandy loam	43	65	85	105	24	30	25	38	115	135	1.5	2.2	3.5	5.0
Cass loam	54	75	100	115	30	35	32	40	125	145	2.0	2.7	4.5	6.0
Cass loam, occasionally flooded	40	63	85	105	18	24	25	38	105	120	1.8	2.4	4.0	5.5
Coly silt loam, 7 to 11 percent slopes	23	38	----	----	14	20	18	28	----	----	1.2	1.8	----	----
Coly silt loam, 11 to 31 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Crete silt loam	46	65	100	115	30	35	30	40	120	145	1.5	2.2	4.0	5.0
Fillmore silt loam	30	45	80	100	10	18	25	34	85	105	1.0	1.5	3.5	4.5
Geary silt loam, 3 to 7 percent slopes	45	63	80	100	25	32	30	40	95	115	1.4	1.9	3.5	4.5
Geary silt loam, 7 to 11 percent slopes	33	51	----	----	20	27	23	34	----	----	1.0	1.5	----	----
Geary silt loam, 11 to 31 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Geary silty clay loam, 3 to 7 percent slopes, eroded	22	35	70	85	14	20	18	28	75	90	1.0	1.5	2.8	4.0
Geary silty clay loam, 7 to 11 percent slopes, eroded	18	32	----	----	14	20	16	26	----	----	.8	1.0	----	----
Hall silt loam	52	70	100	115	30	37	38	48	125	145	2.1	2.4	4.5	6.0
Hastings silt loam, 0 to 1 percent slopes	50	70	100	115	30	35	35	45	125	145	2.0	2.3	4.5	6.0
Hastings silt loam, 1 to 3 percent slopes	48	66	95	110	28	34	31	39	120	140	1.7	2.0	4.3	5.8
Hastings silt loam, thin solum variant	48	68	95	115	30	35	32	43	125	145	2.2	2.7	5.0	6.0
Hersh fine sandy loam, 3 to 7 percent slopes	32	43	65	80	18	23	14	22	70	80	1.1	1.6	3.1	3.9
Hersh-Kenesaw complex, undulating	42	63	85	105	24	31	25	35	110	135	1.7	2.3	4.0	5.0
Hobbs silt loam	56	75	105	115	30	35	40	48	135	150	2.2	2.7	5.0	6.0
Hobbs silt loam, occasionally flooded	45	63	90	105	18	24	31	40	105	125	2.0	2.5	4.0	5.5
Holder silt loam, 0 to 1 percent slopes	52	72	100	115	30	35	36	46	130	145	2.1	2.4	4.5	6.0
Holder silt loam, 1 to 3 percent slopes	49	67	95	110	27	34	32	42	125	140	1.9	2.2	4.3	5.8
Holder silt loam, 3 to 7 percent slopes	45	63	85	100	25	32	30	40	100	120	1.5	1.9	3.5	4.5
Holder silt loam, 7 to 11 percent slopes	30	48	----	----	20	25	22	33	----	----	1.2	1.6	----	----
Holder silt loam, 3 to 7 percent slopes, eroded	36	54	80	100	20	27	25	35	90	105	1.4	1.9	3.5	4.5
Holder silty clay loam, 3 to 7 percent slopes, severely eroded	28	41	75	90	19	25	21	31	80	95	1.0	1.6	3.0	4.0
Holder silty clay loam, 7 to 11 percent slopes, severely eroded	23	38	----	----	16	22	18	28	----	----	.9	1.5	----	----
Hord silt loam, 0 to 1 percent slopes	53	73	100	115	30	35	37	46	130	150	2.1	2.5	4.5	6.0
Hord silt loam, terrace, 0 to 1 percent slopes	55	74	105	115	30	35	38	48	130	150	2.1	2.6	4.5	6.0
Hord silt loam, terrace, 1 to 3 percent slopes	53	73	100	110	29	34	34	44	125	145	2.0	2.4	4.3	5.8
Inavale fine sandy loam	25	35	55	75	15	20	20	30	60	80	1.3	1.8	2.0	3.5
Inavale loamy fine sand	18	26	45	70	10	14	14	26	50	75	.9	1.2	2.0	3.5
Kenesaw silt loam, 0 to 1 percent slopes	45	65	95	115	28	35	30	40	125	145	2.3	2.3	5.0	6.0
Kenesaw silt loam, 1 to 3 percent slopes	44	62	90	110	26	33	27	37	120	140	2.0	2.6	4.8	5.8
Kenesaw silt loam, 3 to 7 percent slopes	40	57	80	100	20	28	23	33	95	120	1.8	2.2	3.5	4.5
Kenesaw silt loam, terrace, 0 to 1 percent slopes	45	65	95	115	26	33	30	40	125	145	2.2	2.8	4.5	6.0
Lex and Alda soils	40	61	85	110	25	31	27	35	100	130	2.5	3.5	4.0	5.0
Marsh	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Meadin sandy loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Platte loam	----	----	50	65	----	----	----	----	55	75	----	----	2.5	3.5
Riverwash	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rough broken land, loess	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rusco silt loam	40	58	90	105	24	31	27	36	110	130	1.8	2.4	4.0	5.0
Scott silt loam	10	15	----	----	----	----	8	15	----	----	----	----	----	----
Silty alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Spoil banks	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Thurman-Valentine loamy fine sands, undulating	14	22	----	----	8	12	10	22	----	----	.8	1.1	----	----
Valentine loamy fine sand, rolling	----	----	----	----	----	----	----	----	----	----	----	----	----	----

of the vegetation is climax; *good* if 51 to 75 percent is climax; *fair* if 26 to 50 percent is climax; and *poor* if 0 to 25 percent is climax.

Management and improvement practices.—Management practices that maintain or improve range condition are needed on all rangeland, regardless of other practices used. The practices needed are proper grazing use, deferred grazing, and planned grazing systems. The proper distribution of livestock in a pasture can be improved by correctly locating fences, livestock water developments, and salting facilities.

A practice that improves range condition is range seeding. This is the establishment of native grasses by seeding or reseeding either wild harvest or improved strains on soils that are suitable for use as range. Coly silt loam, 11 to 31 percent slopes, and Holder silty clay loam, 7 to 11 percent slopes, severely eroded, are examples of soils that are still used for crops but can be range seeded. The most important grasses used in seed mixtures include big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama. No special care other than management of grazing is needed to maintain forage composition.

Description of range sites

The range sites in Adams County are Subirrigated, Silty Lowland, Sandy Lowland, Silty Overflow, Clayey Overflow, Sands, Sandy, Silty, Clayey, Limy Upland, Shallow to Gravel, and Thin Loess (fig. 21). These range sites are described in this subsection. The descriptions include the topography of each site, a brief description of the mapping units, the dominant vegetation when the site is in excellent condition and in poor condition, and the total annual production in pounds per acre, air-dry weight, for years when rainfall is average and the site is in excellent condition.

The names of the soil series and land types represented in a range site are named in the descriptions of the range site, but this does not mean that all the soils of a given series appear in that site. To find the names of all the soils in any given site, refer to the "Guide to Mapping Units" at the back of this survey. Marsh, Riverwash, and Scott silt loam are not assigned to a range site, because the vegetation that grows is not stable.

SUBIRRIGATED RANGE SITE

This site consists of soils of the Alda, Lex, and Platte series. These soils have a water table at a depth of 2 to 6 feet. They are on bottom lands along the Platte River. The kind of vegetation that grows on this site is determined mainly by the moderately high water table, which remains within the root zone during the growing season. The soils differ in depth and texture and have underlying material of coarse sand and gravel. They are calcareous at or near the surface.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye. These comprise at least 75 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Western wheatgrass and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of Kentucky bluegrass, foxtail barley, heath aster, green muhly, blue verbena, small amounts of western wheatgrass and members of the sedge family, and isolated invader shrubs and trees.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 5,000 pounds in unfavorable years to 6,000 pounds in favorable years.

SILTY LOWLAND RANGE SITE

This site consists of soils of the Hobbs, Hord, and Kenesaw series. These are nearly level to gently sloping soils on bottom lands or stream terraces. Their surface layer and subsoil are silt loam. The kind of vegetation that grows is determined mainly by the additional moisture received as runoff from higher soils, the high available water capacity of the soil, and the moderate permeability.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, and Canada wildrye. These comprise at least 70 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Western wheatgrass, blue grama, side-oats grama, sand dropseed, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of Kentucky bluegrass, western wheatgrass, blue grama, buffalograss, sand dropseed, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 3,500 pounds in unfavorable years to 4,500 pounds in favorable years.

SANDY LOWLAND RANGE SITE

This site consists of the well-drained Cass soils and the excessively drained Inavale soils. These are nearly level to hummocky soils on bottom lands. Their texture ranges from loam to loamy fine sand in the surface layer and from fine sandy loam to fine sand in the underlying material. The kind of vegetation that grows is determined mainly by the availability of additional moisture from a water table that is 6 to 9 feet below the surface.

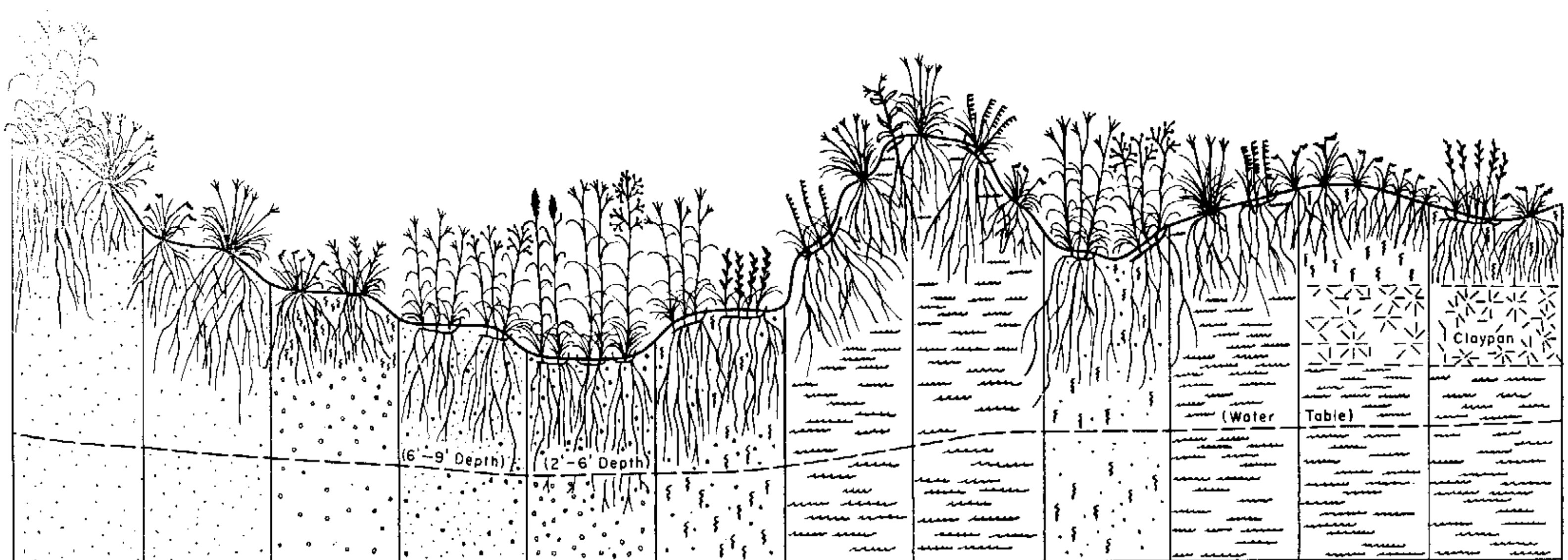
The climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, indiangrass, needle-and-thread, and Canada wildrye. These comprise at least 70 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Prairie sandreed, blue grama, Scribner panicum, sand dropseed, western wheatgrass, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of sand dropseed, blue grama, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 3,000 pounds in unfavorable years to 4,000 pounds in favorable years.

SILTY OVERFLOW RANGE SITE

This site consists of soils of the Hobbs and Rusco series and Silty alluvial land. Included also is the Alluvial land part of Breaks-Alluvial land complex. These nearly level or gently sloping soils are on bottom lands or in upland basins and are occasionally flooded. They are silt loam in their surface layer and range from loam to silty clay loam in their subsoil. The kind of vegetation that grows is determined mainly by the availability of additional water received from periodic overflow or as runoff from higher

ADAMS COUNTY RANGE SITES AND REPRESENTATIVE SOILS



Range Site	Sands	Sandy	Shallow to Gravel	Sandy Lowland	Subirrigated	Silty Lowland	Thin Loess	Limy Upland	Silty Overflow	Silty	Clayey	Clayey Overflow
Soil Series or Land Type	Valentine	Anselmo	Meadin	Cass	Platte	Hord	Rough Broken Land, Loess	Coly	Silty Alluvial Land	Hastings	Crete	Fillmore

Figure 21.—**Relationship of range sites to general topography. A representative soil series or land type is given for each range site.**

lying soils, the high available water capacity, and the moderate to moderately slow permeability of the soils.

The climax cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, switchgrass, and Canada wildrye. These comprise at least 65 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Western wheatgrass, side-oats grama, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of Kentucky bluegrass, western wheatgrass, Baldwin ironweed, blue grama, buffalograss, and annual bromes.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 4,000 pounds in unfavorable years to 4,500 pounds in favorable years.

CLAYEY OVERFLOW RANGE SITE

Fillmore silt loam is the only soil in this site. This nearly level soil is in upland depressions that are subject to occasional flooding by water from higher elevations. The surface layer is silt loam, and the subsoil is silty clay. Internal drainage is poor. The kind of vegetation that grows is determined mainly by excess water and slow permeability.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, and Canada wildrye. These make up at least 50 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Western wheatgrass, blue grama, buffalograss, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of Kentucky bluegrass, western wheatgrass, blue grama, buffalograss, western ragweed, and members of the sedge family.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 2,500 pounds in unfavorable years to 3,500 pounds in favorable years.

SANDS RANGE SITE

Valentine loamy fine sand, rolling, is the only soil in this site. This soil has slopes ranging from 3 to 17 percent. It is loamy fine sand in the surface layer and fine sand in the underlying material. It is excessively drained. The kind of vegetation that grows is primarily determined by the deep storage of moisture that is readily released to plants.

The climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, sand lovegrass, switchgrass, indiangrass, prairie junegrass, and Canada wildrye. These make up at least 60 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Prairie sandreed, blue grama, needle-and-thread, sand dropseed, sand paspalum, Scribner panicum, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, sand dropseed, Scribner panicum, purple lovegrass, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 2,500 pounds in unfavorable years to 3,000 pounds in favorable years.

SANDY RANGE SITE

This site consists of undulating soils of the Anselmo, Hersh, Thurman, and Valentine series. These are deep, well-drained to excessively drained soils on uplands. They range from fine sandy loam to loamy fine sand in their surface layer and from fine sandy loam to fine sand in their subsoil. The kind of vegetation that grows is determined mainly by the moderately rapid to rapid permeability.

The climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, side-oats grama, indiangrass, prairie junegrass, and needle-and-thread. These make up at least 65 percent of the total plant cover, and other perennial grasses and forbs account for the rest. Prairie sandreed, western wheatgrass, blue grama, sand dropseed, Scribner panicum, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, sand dropseed, Scribner panicum, purple lovegrass, sand paspalum, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 2,500 pounds in unfavorable years to 3,000 pounds in favorable years.

SILTY RANGE SITE

This site consists of soils of the Geary, Hall, Hastings, Holder, Hord, and Kenesaw series and the Hastings series, thin solum variant. These soils are on uplands. Also in the site are Spoil banks and the Breaks part of Breaks-Alluvial land complex. The soils range from silt loam to silty clay loam in their surface layer, subsoil, and underlying material. The kind of vegetation that grows is determined mainly by the moderate to moderately slow permeability.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass. These make up at least 55 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Blue grama, buffalograss, side-oats grama, sand dropseed, and western wheatgrass are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, buffalograss, sand dropseed, western wheatgrass, purple lovegrass, plains pricklypear, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 3,000 pounds in unfavorable years to 3,500 pounds in favorable years.

CLAYEY RANGE SITE

This site consists of soils of the Butler and Crete series. These are deep, moderately well drained to somewhat poorly drained, nearly level soils on uplands. They have a silt loam surface layer and a silty clay subsoil. The vegetation that grows is mainly a result of the slow permeability in the claypan subsoil.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, and side-oats grama. These make up at least 45 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Blue grama, buffalograss, tall dropseed, and western wheatgrass are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama,

buffalograss, tall dropseed, western wheatgrass, western ragweed, blue verbena, and annual bromes.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 3,000 pounds in unfavorable years to 3,500 pounds in favorable years.

LIMY UPLAND RANGE SITE

This site consists of soils of the Coly series. These are deep, strongly sloping to steep soils on uplands. They formed in loess and are calcareous at or near the surface. The soils are well drained to somewhat excessively drained and are silt loam throughout the profile. The kind of vegetation that grows is determined mainly by the good soil-water relationship and the calcareous nature of the soils.

The climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, switchgrass, indiangrass, and plains muhly. These make up at least 60 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Blue grama, side-oats grama, buffalograss, Scribner panicum, sedges, and western wheatgrass are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, buffalograss, plains pricklypear, and western ragweed.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 2,000 pounds in unfavorable years to 2,500 pounds in favorable years.

SHALLOW TO GRAVEL RANGE SITE

Meadin sandy loam is the only soil in this site. This soil is on stream terraces. It is shallow over mixed sand and gravel. It is excessively drained and has rapid permeability in the underlying material. The kind of vegetation that grows is determined mainly by the low available water capacity, which makes the soil droughty.

The climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, prairie sandreed, side-oats grama, and needle-and-thread. These comprise at least 65 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Blue grama, sand dropseed, western wheatgrass, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, hairy grama, sand dropseed, purple lovegrass, tumblegrass, curlycup gumweed, western ragweed, woolly verbena, and clubmoss.

Where the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 1,500 pounds in unfavorable years to 2,000 pounds in favorable years.

THIN LOESS RANGE SITE

Rough broken land, loess, is the only mapping unit in this site. This is a very steep land type on uplands. Little or no soil development has taken place. There are many catsteps and landslips. The soil material is silty and well drained internally. The kind of vegetation that grows is determined mainly by steepness of slope, excessive runoff, lack of soil development, and the calcareous soil material.

The climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, plains muhly, prairie junegrass, and needle-and-thread. These make up at least 70 percent of the total plant volume, and other perennial grasses and forbs account for the rest. Blue grama, Scribner panicum, sand dropseed, tall dropseed, western wheatgrass, and members of the sedge family are the principal increasers. The typical plant community, where the site is in poor condition, consists of blue grama, Scribner panicum, sand dropseed, broom snakeweed, western ragweed, and various annuals.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry forage per acre ranges from 2,000 pounds in unfavorable years to 3,500 pounds in favorable years.

Use of the Soils for Woodland and Windbreaks [4]

This section discusses the woodland in Adams County and gives information about the use of soils for windbreaks. It also discusses windbreak suitability groups.

Woodlands

Native woodland in Adams County is limited to relatively narrow strips along the larger streams. The most extensive stands grow on bottom lands along the Little Blue River. These stands, made up mostly of American elm, boxelder, green ash, hackberry, willow, walnut, cottonwood, and some woody shrubs, are in areas of Cass and Platte soils and Silty alluvial land. Much of this woodland is grazed and now contains many undesirable trees. Black walnut, which has a ready market and a high value, is being depleted rapidly. Under proper management, this species could be established and the stands would become a source of future income as well as a means of controlling erosion along the streambanks.

Early settlers in Adams County planted trees for protection, shade, and fenceposts. Throughout the years, landowners have continued to plant trees to protect their buildings and livestock. Native trees and shrubs contribute a great deal to the natural beauty of the landscape in the county. Their presence benefits wildlife by producing food and cover.

Windbreaks

One of the most important uses for trees in Adams County is for windbreaks. Because native trees are scarce and extremes in weather are severe, windbreaks are needed for protection of farmsteads, livestock, and the soils. Windbreaks help to reduce the cost of heating homes, control snow drifting, provide shelter for livestock, improve conditions for wildlife, and beautify the home and countryside.

Although trees are not easily established in the county, observing the basic rules of tree culture can result in a high degree of tree survival. Healthy seedlings of suitable species that are maintained in good condition and properly planted in a prepared soil site can survive and grow well. They require care after planting if they are to continue to survive.

Table 3 gives the relative vigor and expected height of trees suitable for windbreaks in this county at 20 years of age. Detailed measurements of trees were taken on soils of the major windbreak suitability groups that are in this county. Soils that have been placed in each group are listed in the description of the groups. The soils in each

[4] By JAMES W. CARR, JR., forester, Soil Conservation Service.

***Figure 22.*—Young farmstead windbreak, 2 to 3 years old, on a Hastings soil. These eastern redcedars are properly cultivated between the rows and will grow rapidly under excellent care.**

group are similar in their characteristics that affect tree growth (fig. 22).

Ratings in table 3 are based on observations of general vigor and condition of the trees. A rating of *excellent* indicates that the trees are growing well. The leaves have good color, there are no dead branches in the upper part of the crown, and there is no indication of damage by fungi or insects. A rating of *good* indicates that the trees are growing moderately well. There are only a few dead branches and some die-back in the upper part of the crown, and there is slight indication of damage by fungi or insects. A rating of *fair* indicates that at least half of the trees have a significant number of dead branches in the upper part of the crown and about one-fourth of the trees are dead. The growth has slowed significantly, and there are indications of moderate damage by fungi or insects. A rating of *poor* indicates that the living trees that remain have had severe die-back, more than one-fourth of the trees in the stand are dead, and there are indications of severe damage by fungi or insects.

Detailed measurements show that eastern redcedar and ponderosa pine, both native to Nebraska, are the trees best suited to use in windbreaks. Both are rated high in survival and vigor. They hold their leaves through the winter and thereby give maximum protection when it is most needed.

Table 3 also lists several broadleaf trees that are well suited to use in windbreaks in Adams County. The best broadleaf trees are honeylocust, green ash, hackberry, and mulberry. Suitable shrubs are lilac, bush honeysuckle, American plum, and chokecherry. The windbreak study showed that eastern redcedar can be expected to grow slightly less than 1 foot in height per year and that trees can reach a mature height of 25 to 35 feet. Ponderosa pine and broadleaf trees grow slightly faster and will probably be somewhat taller at maturity.

Rate of growth in a windbreak varies widely with the content of soil moisture. Soil fertility, exposure, and arrangement of species within the planting also have a marked effect on growth. Some species grow more rapidly than others. Some make an early, rapid growth but tend to die young. This is sometimes true of cottonwood. Siberian elm and Russian-olive grow vigorously in their early years. They can, however, spread to areas where they are not wanted and can be short lived. Boxelder and mulberry commonly freeze back in severe winters, and green ash is susceptible to damage by borers.

A good windbreak needs to be designed to fit the soils in which it is to grow. The intended purpose of the planting needs to be considered. Specific information on design, establishment, and care of windbreaks is available from the Soil Conservation Service and the Extension Service forester serving the county.

Windbreak suitability grouping

The soils of Adams County are grouped according to characteristics that affect tree growth. The soil series represented in the windbreak suitability groups are named in the description of the group, but this does not mean that all the soils of a given series are in a given group. To find the names of all the soils in any group, refer to the "Guide to Mapping Units" at the back of the survey. Soils in a group produce similar growth and survival under normal conditions of weather and care. Following is a brief description of the windbreak suitability groups in Adams County.

TABLE 3.—*Relative vigor and estimated height of trees at 20 years of age on soils of the major windbreak suitability groups*

Species	Silty to clayey		Sandy		Very sandy		Moderately wet		Shallow	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Ft.		*Ft.*		*Ft.*		*Ft.*		*Ft.*
Boxelder	(1)	(1)	Excellent	24	Fair	17	Excellent	18	Poor	(2)
Cottonwood	Poor	(2)	Good	48	Excellent	45	Good	52	Poor	(2)
Eastern redcedar	Excellent	20	Excellent	20	Excellent	18	Excellent	18	Excellent	16
Green ash	Good	22	Good	24	Good	23	Good	21	Poor	(2)
Hackberry	Good	21	Good	21	Fair	16	Good	(1)	Poor	(2)
Honeylocust	Good	26	Good	25	Good	16	Good	(1)	Poor	(2)
Ponderosa pine	Excellent	25	Excellent	27	Excellent	26	Poor	(2)	(1)	(1)
Russian mulberry	Excellent	20	Excellent	15	Good	17	Excellent	27	Poor	(2)
Russian-olive	Fair	18	Fair	23	Fair	17	Poor	(2)	Poor	(2)

[1] Sufficient data not available.
[2] Most of the trees are dead or dying.

SILTY TO CLAYEY WINDBREAK SUITABILITY GROUP

This group consists of soils of the Anselmo, Butler, Cass, Coly, Crete, Greary, Hall, Hastings, Hobbs, Holder, Hord, and Kenesaw series; the Hastings series, thin solumn variant; and Spoil banks. These are deep, nearly level to steep soils and land types on uplands, stream terraces, and bottom lands. They have a loam to silty clay loam surface layer. Their subsoil and underlying material are mainly silt loam to silty clay loam, but Anselmo and Cass soils have a fine sandy loam subsoil and Butler and Crete soils have a claypan subsoil. Permeability is moderately rapid to slow, and available moisture capacity is moderate to high.

These soils and land types generally provide good sites for planted trees, and the survival and growth of suitable species are good. Drought and competition from weeds and grasses for moisture are the principal limitations. Water erosion is a hazard in gently sloping to steep areas.

Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar, ponderosa pine, Rocky Mountain juniper, Austrian pine, and Scotch pine.
Tall broadleaf trees: Hackberry, honeylocust, bur oak, green ash, and boxelder.
Low broadleaf trees: Russian mulberry.
Shrubs: Lilac, cotoneaster, honeysuckle, chokecherry, and American plum.

SANDY WINDBREAK SUITABILITY GROUP

This group consists of soils of the Anselmo, Cass, Hersh, Inavale, Thurman, and Valentine series. These deep, nearly level to moderately sloping soils are on uplands, stream terraces, and bottom lands. The surface layer is fine sandy loam to loamy fine sand. The subsoil and underlying material range from fine sandy loam to fine sand. Permeability is moderately rapid to rapid, and available water capacity is moderate to low.

These soils are suited to windbreak plantings if soil blowing is controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation generally needs to be restricted to the tree rows. Drought and competition from grass and weeds for moisture are limitations. Water erosion can be a hazard in sloping areas.

Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, and Scotch pine.
Tall broadleaf trees: Honeylocust and green ash.
Low broadleaf trees: Russian mulberry and boxelder.
Shrubs: Lilac, cotoneaster, skunkbush sumac, and American plum.

VERY SANDY WINDBREAK SUITABILITY GROUP

Valentine loamy fine sand, rolling, is the only soil in this group. This is a deep, excessively drained soil on uplands. The surface layer is loamy fine sand, and the underlying material is fine sand. Slopes range from 3 to 17 percent. Permeability is rapid, and available water capacity is low.

This soil is so loose that trees need to be planted in shallow furrows and not cultivated. Young seedlings can be damaged by high winds and be covered by drifted sand.

Trees suitable for planting are—

Conifers: Eastern redcedar, Rocky Mountain juniper, Austrian pine, Scotch pine, and ponderosa pine.

SHALLOW WINDBREAK SUITABILITY GROUP

Meadin sandy loam is the only soil in this group. This is an excessively drained soil on stream terraces. The surface layer is sandy loam that grades to coarse sand and gravel at a depth of 10 to 20 inches. Slopes range from 0 to 3 percent. Permeability is rapid, and available water capacity is low.

A limited rooting zone and a low available water capacity are the main limitations on this site. Planted trees are damaged by drought in most years.

The only tree suitable for planting is eastern redcedar.

MODERATELY WET WINDBREAK SUITABILITY GROUP

This group consists of soils of the Alda, Cass, Fillmore, Hobbs, Lex, Platte, and Fusco series. These soils are in upland depressions or on bottom lands. They are wet because of a high water table or because they are flooded for short periods. The surface layer is mainly loam or silt loam, and the subsoil and underlying material range mainly from fine sandy loam to silty clay loam. Fillmore soils have a claypan subsoil, Lex and Alda soils have coarse sand and gravel at a depth of 20 to 40 inches, and Platte soils have coarse sand and gravel at a depth of 10 to 20 inches. Permeability is moderately rapid to slow. Available water capacity is low to high.

These soils and land types are well suited to windbreak plantings if the species of trees are those that can tolerate occasional wetness. Establishing trees and cultivating between the rows can be difficult in wet years. The abundant and persistent herbaceous vegetation that grows in the tree rows is a management concern because it competes with the trees.

Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar and Austrian pine.
Tall broadleaf trees: Honeylocust, green ash, eastern cottonwood, golden willow, and white willow.
Low broadleaf trees: Russian mulberry.
Shrubs: Red-osier dogwood, buffaloberry, chokecherry, and American plum.

UNDESIRABLE WINDBREAK SUITABILITY GROUP

This group consists of Scott silt loam, Breaks-Alluvial land complex, Marsh, Riverwash, Rough broken land, loess, and Silty alluvial land. This soil and these land types have a wide range of texture. They are too wet or too steep for the satisfactory establishment of trees.

The soil and land types in this group generally are not suitable for planting windbreaks of any kind, because of unfavorable qualities and characteristics. Some areas can be used for recreation and wildlife plantings of tolerant species of trees and shrubs if they are hand planted or if other special approved practices are used.

Use of the Soils for Wildlife and Recreation [5]

Wildlife management requires a knowledge of soils and the kinds of vegetation they are capable of producing. The kind, amount, and distribution of vegetation largely determines the kind and amount of wildlife that can be produced and maintained.

Soil fertility and other characteristics, such as topography, affect the number of wildlife an area can carry. Fertile soils generally produce more wildlife. Water drained from such soils generally produces more fish than that from infertile soils.

Topography affects wildlife through its influence on how the soils can be used. Rough, steep soils present hazards to livestock, and they are impractical to cultivate for crops. Undisturbed vegetation on these sites is valuable for wildlife, and where such cover is lacking, it commonly can be developed.

Permeability and the rate of water infiltration are important soil characteristics in constructing ponds for fish and developing and maintaining wetland habitat for waterfowl. Marsh areas are suited to the development of aquatic and semiaquatic habitat for waterfowl and some species of furbearers.

Those soils that have the largest wildlife population do not rate highest on their potential for producing wildlife. The reason is that the better soils for farming are intensively managed for maximum crop yields rather than for wildlife. Table 4 shows by soil associations the potential for producing wildlife habitat. The ratings of good, fair, poor, and very poor take into account the soils that are present and their characteristics with respect to potential for producing the kind of vegetation needed for wildlife habitat.

The Hastings-Holder association, the Hastings-Crete association, and Crete-Hastings association provide some of the best habitats for pheasants in Adams County. Grain sorghum, corn, wheat, and alfalfa provide an excellent supply of food for this species, and wheat provides nesting areas that are generally undisturbed until after the peak of the pheasant hatch has passed.

Topography in the Hastings-Crete association and the Crete-Hastings association is nearly level and gently sloping. Thus, odd areas suitable for producing permanent wildlife cover are scarce. Fields generally are large. As a result, good interspersion of different habitat types is lacking. Soils of the Hastings-Holder association have steeper slopes and, therefore, a better interspersion of habitat types. The Crete-Hastings association includes areas of Scott soils. These poorly drained soils in upland depressions provide sites in which to create or improve shallow water areas as habitat for waterfowl, furbearers, and other wildlife.

The Valentine-Thurman and the Anselmo-Meadin associations are limited in size and are important primarily for wildlife that require a grassland type of habitat. Productions of crops on the better soils provides a food supply of waste grain for some species of wildlife. Where the nature of the soil and topography is such that crops cannot be grown or cattle grazed, natural vegetation provides good wildlife habitat. Most of the Valentine-Thurman association is in native grass and is used for cattle grazing. Proper use of this grassland is important to wildlife. Where these soils are used within their capability, cover is produced that is valuable for wildlife.

The Little Blue River in the Hord-Cass-Hobbs association provides an important fishery. Catfish, bulhead, and carp grow here. Wooded tracts along streams on bottom lands provide habitat for deer, bobwhite quail, squirrel, and cottontail rabbit. This soil association is also inhabited by furbearers, such as mink, muskrat, and beaver, that require water. Although water is sometimes scarce for these furbearers, habitat is abundant for other furbearers, such as raccoon, opossum, and coyote. Water and marsh areas are also used by waterfowl, chiefly during their migration periods in spring and fall.

Because so much outdoor recreation is connected with water sports, the Little Blue River offers possibilities for recreation developments. Unfortunately, the soils near the river are among the poorest in the county for building sites or for developing outdoor recreation activities. Poor drainage and the hazard of flooding are some of the limitations that need to be considered when developing recreation sites.

The Holder-Geary-Coly association and the Kenesaw-Coly association provide a varied topography. Much of the area in these associations is rough and rolling and provides good sites for constructing dams and creating ponds. Some of these ponds are suitable for producing fish, but the amount of clay held in suspension in the water often creates management problems.

[5] By JAMES W. CARR, forester, Soil Conservation Service.

TABLE 4.—*Potential of soil associations for producing elements of wildlife habitat*

Soil association	Potential for producing—			
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
Anselmo-Meadin	Fair to poor	Good to poor	Good to poor	Very poor.
Crete-Hastings	Fair	Good	Good to poor	Fair to very poor.
Hastings-Crete	Fair	Good	Good	Very poor.
Hastings-Holder	Fair	Good	Good	Very poor.
Holder-Geary-Coly	Fair	Good	Good	Very poor.
Hord-Cass-Hobbs	Good	Good	Good to very poor	Very poor.
Kenesaw-Coly	Fair	Good	Good	Very poor.
Platte-Lex-Alda	Good	Good	Good to very poor	Fair.
Valentine-Thurman	Fair	Good	Good to very poor	Very poor.

The topography of the Holder-Geary-Coly association provides odd areas of natural vegetation in various stages of plant succession that supply both food and cover. The production of wheat and alfalfa in relatively small fields, interspersed with pasture and wooded draws, further enhances the value of the habitat of this association for quail. Much of this association is in native grass because of the steepness of slopes. Proper use of the native grassland, as well as the introduced pastures for grazing livestock, are important to wildlife here. The important game animals include deer, bobwhite quail, pheasant, and cottontail rabbit.

Another fishery in Adams County is in the Platte-Lex-Alda association along the Platte River. Channel catfish are the most important species of fish in the Platte River. Woodland along the bottom lands in this association provides food and cover for a number of nongame and game species. The latter include deer, bobwhite quail, pheasant, squirrel, and cottontail rabbit. Furbearers, such as mink and muskrat, also inhabit this area. Marshy areas in this association and the river channels are used by waterfowl, mainly during spring and fall migrations.

Wildlife is a product of soil and water, and each individual area has a certain capacity for the production of this resource, which is dependent on the habitat provided. For grasslands that are put into crop production, there is a loss of cover for some kinds of animals. In turn, an improved food supply is made available for others.

Where trees and shrubs are planted for field and farmstead windbreaks, another requirement of some species of wildlife is met. Construction of farm ponds can provide additional opportunities for improving habitat for wildlife. Herbaceous and woody plantings around ponds supply cover for wildlife, and property stocking and management can produce sustained crops of fish annually.

Some areas are better suited to wildlife production than to production of other crops. By protecting additional natural cover or by establishing needed cover, conditions can be improved for the production and maintenance of any wildlife species.

Table 5 shows the general requirement of important game species in Adams County for certain kinds of vegetation. The kinds of vegetation rated high or medium are considered essential habitat for the specified kind of game species. Table 4 gives the potential of the soil associations for producing these various kinds of vegetation.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining which species of plants to use can be obtained from the Soil Conservation Service in Hastings, Nebraska. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, the Bureau of Sport Fisheries and Wildlife, and the Federal Extension Service. The Soil Conservation Service provides technical assistance in the planning and application of conservation practices for developing outdoor recreation facilities.

Engineering Uses of the Soils [6]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of highways and roads, airports, pipelines, building foundations, facilities for storing water and controlling erosion, and systems for irrigating and draining soils and for disposing of sewage.

Among the properties most important to engineers are soil texture, permeability, shear strength, plasticity, reaction, compaction characteristics, and available water capacity. Also important are relief, depth to the water table, and depth to bedrock or to sand and gravel. Such information is made available in this subsection. Engineers can use it to—

1. Aid in selecting possible sites for industrial, business, and residential construction and for recreation areas.
2. Select preliminary routes for highways and for ground utilities and routes to airport sites.
3. Determine possible sites for drainage systems, farm ponds, irrigation systems, and for disposing of sewage and runoff from feedlots.
4. Locate sources of borrow materials for highway embankments and for highway subbase, base, and surface courses.
5. Evaluate drainage areas and volumes of surface water runoff for bridge and culvert design.

[6] By JOHN E. OVERING, area engineer, and LARRY G. RAGON, soil scientist, Soil Conservation Service, assisted by ROBERT J. FREDRICKSON, civil engineer, Soil Conservation Service, and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

TABLE 5.—*Relative importance of specified kinds of vegetation for important game species*

[Absence of entry means not applicable]

Wildlife species	Kinds of vegetation and their importance					
	Woody plants		Herbaceous plants		Grain and seed crops	
	Food	Cover	Food	Cover	Food	Cover
Bobwhite quail	Low	High	High	High	High	Low.
Deer	High	High	(1)	Low	High	Low.
Pheasant	Low	High	High	High	High	High.
Waterfowl					High.[2]	

[1] Medium for white-tailed deer; high for mule deer.

[2] For dabbling ducks and geese, principally in spring and fall.

6. Estimate the type and amount of maintenance for structures and vegetation.
7. Estimate the possible corrosion of underground structures.

The engineering interpretations reported here do not eliminate the need for detailed field investigations at the site of specific engineering works. This is particularly important in works involving heavy loads and where excavations are deeper than the depths of layers here reported. The estimates generally are to a depth of 5 feet, and interpretations normally do not apply to greater depths.

Small areas of other soils may be included in the mapping units. These inclusions could be important in engineering planning. The soil map is useful in planning foundation investigations and indicating the kinds of problems that may be expected. The soils of Adams County are so deep that bedrock does not affect their use.

Some of the terms in this soil survey are those used by soil scientists and are defined in the Glossary. Most of the information about engineering is given in tables 6, 7, and 8.

Engineering classification systems

Soils are classified in order that people can communicate in common terms. Two systems of soil classification widely used for engineering purposes are described in the paragraphs that follow. The relationship between these two classification systems and the textural classification used by the U.S. Department of Agriculture is indicated in table 7.

AASHO classification.—The American Association of State Highway Officials (AASHO) (*1*) has developed a classification based on the field performance of soil material. In this system seven groups of soils are classified on the basis of field performance. The groups are classified from A–1 (sand and gravel having high bearing capacity) to A–7 (soils having low bearing capacity when wet). Soils in the A–1, A–2, and A–3 groups are mostly sand and gravel mixtures; those in the A–4 through A–7 groups are mostly silt and clay mixtures. A sand, silt, and clay soil is further classified by identifying the silt and clay parts. Thus, an A–2–4 soil is an A–2 sand with an A–4 type of silt-clay mixture included.

The probable performance of the soil on the site is indicated by a group index number. The group index number, shown in parentheses in table 6, ranges from 0 to 20 and is a rating of field performance of the soil. Thus, a soil classified as A–2–4 (0) is one of the best for highway construction. A soil having a group index number of 20 is one of the least desirable for highway location or construction.

The Nebraska Department of Roads uses a group index of —4 to 32 instead of 0 to 20. This enlarged group index bracket allows plastic and nonplastic, fine-grained soils occurring in sands to be evaluated and the effect of a high content of clay (group index greater than 20) to be determined.

Unified classification.—Many engineers, including those with the Soil Conservation Service, Bureau of Reclamation, and Corps of Engineers, use the Unified classification (*10*). Soils are classified generally as coarse grained, fine grained, and organic or peat.

Fine-grained soils are classified according to plasticity characteristics. Coarse-grained soils are classified primarily according to gradation, and organic soils are classified according to odor and plasticity change after ovendrying.

In the Unified system, combinations of letters are used to identify soil materials and certain properties: G is used for gravel, S for sand, C for clay, M for silt, W for well graded, P for poor graded, L for low liquid limit, and H for high liquid limit.

Two letters are combined to classify the soil; for example, SP is a sand that is poorly graded, CL is a clay having low plasticity, and GC is a mixture of gravel and clay. There are 12 possible inorganic classifications and three possible organic classifications. Organic (OL and OH) and peat (Pt) soils are uncommon in Nebraska.

In tables 6 and 7, the soils of Adams County are classified as SP, SW, SP-SM, SP-SC, SM, SC, ML, ML–CL, CL, and CH. Soils that have borderline characteristics of two classifications are given a dual classification; for example, ML–CL.

Engineering test data

Table 6 shows engineering test data for several soils in Adams County. These soils represent some of the most extensive soils in the county; they make up about 47 percent of the total acreage. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads, according to standard procedures of the American Association of State Highway Officials.

Each soil listed in table 6 was sampled at only one location, and the data given for the soil are those at that location. From one location to another, a soil can differ considerably in characteristics that affect engineering. Even where soils are sampled at more than one location, the test data probably do not show the widest range in characteristics.

The engineering classifications in table 6 are based on data obtained by mechanical analysis and on tests to determine the liquid limit and plastic limit. The mechanical analysis was made by a combination of the sieve and hydrometer methods.

Tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As the moisture content of a clay soil is increased from a dry condition, the soil changes from a solid to a plastic state and then to a liquid state. The *plastic limit* is that moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil passes from a solid to a plastic state. The *liquid limit* is that moisture content at which the soil passes from a plastic to a liquid state. The *plasticity index* is the numerical difference in percent moisture between the liquid limit and the plastic limit. It indicates a range of moisture content within which soil is considered to be plastic. Some silty and sandy soils are nonplastic, which means they will not become plastic at any moisture content.

Engineering properties of the soils

In table 7 soil properties significant to engineering are estimated. For detailed information about the soils, refer to the section "Descriptions of the Soils," and for information about geology, to the section "Formation and Classification of the Soils."

TABLE 6.—*Engineering*

[Tests performed by the Nebraska Department of Roads in accordance with

Soil name and location	Parent material	Report No.	Depth from surface
			Inches
Butler silt loam: 0.25 mile N. and 100 feet E. of SW. corner sec. 5, T. 8 N., R. 10 W. (Modal).	Peoria loess.	S68-2119	6–13
		S68-2120	15–28
		S68-2121	44–72
Cass loam, occasionally flooded: 0.35 mile N. and 70 feet E. of SW. corner sec. 10, T. 5 N., R. 11 W. (Modal).	Alluvium.	S68-2101	0–6
		S68-2102	15–30
		S68-2103	38–47
Hastings silt loam: 0.40 mile E. and 50 feet S. of NW. corner sec. 15, T. 6 N., R. 11 W. (Modal).	Peoria loess.	S68-2107	0–8
		S68-2108	14–21
		S68-2109	41–72
Hobbs silt loam: 0.15 mile S. and 100 feet E. of NW. corner of NE. quarter sec. 33, T. 7 N., R. 11 W. (Modal).	Alluvium.	S68-2110	0–7
		S68-2111	15–23
		S68-2112	45–72
Holder silt loam: 0.30 mile N. and 100 feet E. of SW. corner sec. 9, T. 7 N., R. 11 W. (Modal).	Peoria loess.	S68-2116	0–6
		S68-2117	14–23
		S68-2118	38–72
Holder silty clay loam: 0.30 mile N. and 400 feet W. of SE. corner sec. 17, T. 5 N., R. 10 W. (Modal).	Peoria loess.	S68-2113	0–5
		S68-2114	5–13
		S68-2115	26–72
Hord silt loam, terrace: 300 feet S. and 50 feet W. of NE. corner sec. 15, T. 5 N., R. 11 W. (Modal).	Alluvium.	S68-2104	6–15
		S68-2105	15–30
		S68-2106	50–72
Kenesaw silt loam: 0.40 mile N. and 140 feet E. of SW. corner sec. 27, T. 7 N., R. 12 W. (Modal).	Loess.	S68-2098	0–6
		S68-2099	16–28
		S68-2100	28–72
Valentine loamy fine sand: 75 feet W. and 125 feet N. of SE. corner sec. 19, T. 6 N., R. 12 W. (Modal).	Eolian sand.	S68-2096	0–5
		S68-2097	12–72

[1] Mechanical analyses according to AASHO Designation T 88-47(*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

test data

standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [1]— Percentage passing sieve— No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25) mm.)	No. 200 (0.074 mm.)	Percentage smaller than— 0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	Liquid limit	Plasticity index	Classification AASHO [2]	Unified [3]
								Pct.			
---------	100	98	95	84	40	24	20	30	7	A-4(8)	ML-CL
100	99	98	96	89	71	55	48	59	34	A-7-6(20)	CH
---------	---------	100	98	91	50	27	20	38	13	A-6(9)	ML-CL
100	99	97	81	70	43	24	19	30	10	A-4(8)	CL
---------	100	99	69	41	20	12	10	23	1	A-4(7)	ML
---------	---------	100	91	80	45	22	17	33	11	A-4(8)	ML-CL
---------	---------	100	99	91	50	29	24	33	11	A-6(8)	ML-CL
---------	---------	100	99	93	66	45	39	56	32	A-7-6(19)	CH
---------	---------	100	99	92	54	29	20	38	14	A-6(10)	ML-CL
---------	---------	100	99	93	48	26	21	34	11	A-6(8)	ML-CL
---------	---------	100	98	88	47	25	20	34	10	A-4(8)	ML-CL
---------	100	98	85	76	36	20	19	27	6	A-4(8)	ML-CL
---------	---------	100	99	92	46	26	23	33	10	A-4(8)	ML-CL
---------	---------	100	98	91	61	38	31	49	25	A-7-6(16)	CL
---------	---------	100	99	93	45	22	15	34	9	A-4(8)	ML-CL
---------	---------	100	98	92	55	39	33	46	21	A-7-6(14)	ML-CL
---------	---------	100	99	92	60	36	31	46	22	A-6-7(14)	CL
---------	---------	100	99	94	52	24	16	36	12	A-6(9)	ML-CL
---------	100	99	92	81	46	25	20	36	14	A-6(10)	CL
---------	---------	100	98	81	61	35	29	42	19	A-7-6(12)	CL
---------	---------	100	97	89	53	29	21	36	14	A-6(10)	CL
---------	100	99	98	92	44	24	14	32	8	A-4(8)	ML-CL
---------	---------	100	99	94	50	27	21	36	13	A-6(9)	ML-CL
---------	100	99	98	93	52	24	16	35	12	A-6(9)	ML-CL
---------	100	82	18	14	10	5	4	([4])	([4])	A-2-4(0)	SM
100	96	71	7	4	4	4	4	([4])	([4])	A-3(0)	SP-SM

[2] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49.

[3] Based on the Unified Soil Classification System, Military Standard No. 619B, Dept. of Defense, June, 1968. SCS and BPR have agreed that all soils having plasticity indexes within 2 points of A-line are to be given a borderline classification, such as ML-CL.

[4] Nonplastic.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column of this table.

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel	Depth from surface of typical profile	Classification: Dominant USDA texture
	Feet	*Feet*	*Inches*	
Alda	2-6	2-3	0-13	Loam
Mapped only in an undifferentiated group with Lex soils.			13-26	Fine sandy loam
			26-60	Sand and gravel
Anselmo:				
2An, 2AnA	6-10	[2] 3-6	0-10	Fine sandy loam
			10-30	Fine sandy loam
			30-60	Sand
2Ap	6-10	[2] 5-8	0-12	Loam
			12-26	Fine sandy loam
			26-60	Fine sandy loam
Breaks-Alluvial land complex: By. Properties too variable to be estimated.				
Butler: Bu	>10	>10	0-15	Silt loam
			15-44	Silty clay
			44-60	Silt loam
Cass:				
Cs	6-15	[2] 3-6	0-8	Fine sandy loam
			8-30	Fine sandy loam
			30-60	Stratified.
Cm, 2Cm	6-15	[2] 5-8	0-8	Loam
			8-30	Fine sandy loam
			30-60	Stratified.
Coly: CbC, CbD	>10	>10	0-5	Silt loam
			5-60	Silt loam
Crete: Ce	>10	>10	0-11	Silt loam
			11-26	Silty clay
			26-60	Silt loam
Fillmore: Fm	>10	>10	0-15	Silt loam
			15-56	Silty clay
			56-60	Silt loam
Geary:				
GsB, GsC, GsE	>10	>10	0-10	Silt loam
			10-43	Silty clay loam
			43-60	Silty clay loam
GeB2, GeC2	>10	>10	0-6	Silty clay loam
			6-26	Silty clay loam
			26-60	Silty clay loam
Hall: Ha	10-20	10-20	0-14	Silt loam
			14-42	Silty clay loam
			42-60	Silt loam
Hastings: Hs, HsA	>10	>10	0-11	Silt loam
			11-41	Heavy silty clay loam
			41-60	Silt loam
Hastings, thin solum variant: 2Hs	>10	>10	0-7	Silt loam
			7-22	Heavy silty clay loam
			22-60	Silt loam
*Hersh: HmB, HR	>10	[2] 5-8	0-8	Fine sandy loam
For Kenesaw part of HR, see Kenesaw series.			8-60	Fine sandy loam

See footnotes at end of table.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for The sign > means more than; the sign < means less than]

Classification—Continued		Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permea-bility	Available water capacity	Shrink-swell potential
Unified [1]	AASHO [1]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
						Percent	*Inches per hour*	*Inches per inch of soil*	
CL or ML	A-4	90-100	85-100	70-95	51-75	3-10	0. 6-2. 0	0. 20-0. 22	Low.
SM or ML	A-4	100	90-100	70-98	36-55	3-10	2. 0-6. 0	0. 15-0. 17	Low.
SP-SM, SP, or SW	A-1	90-100	60-100	5-40	0-10	0-5	>20	0. 02-0. 04	Low.
SM or ML	A-4	100	98-100	70-98	36-55	10-18	2. 0-6. 0	0. 16-0. 18	Low.
SM or ML	A-4	100	98-100	70-98	36-55	7-12	2. 0-6. 0	0. 15-0. 17	Low.
SM, SW, or SP	A-3, A-2, or A-1	100	98-100	36-95	3-20	0-12	6. 0-20. 0	0. 05-0. 07	Low.
CL or ML	A-4 or A-6	90-100	85-100	31-95	51-75	10-27	0. 6-2. 0	0. 20-0. 22	Low.
SM or ML	A-4	90-100	90-100	70-98	36-55	7-12	2. 0-6. 0	0. 15-0. 17	Low.
SM or ML	A-4	90-100	90-100	70-98	36-55	7-12	2. 0-6. 0	0. 14-0. 16	Low.
ML or CL	A-4 or A-6	--------	100	98-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Moderate.
CH	A-7	--------	100	99-100	96-100	40-55	0. 06-0. 2	0. 11-0. 13	High.
ML or CL	A-6	--------	100	98-100	90-100	18-27	0. 6-2. 0	0. 20-0. 22	Moderate.
SM or ML	A-4	--------	100	95-100	36-55	10-18	2. 0-6. 0	0. 16-0. 18	Low.
ML, SM, or SM-SC	A-4	--------	100	70-100	36-70	7-20	2. 0-6. 0	0. 15-0. 17	Low.
CL or ML	A-4 or A-6	--------	100	70-95	51-85	10-27	0. 6-2. 0	0. 20-0. 22	Low.
ML, SM, or SM-SC	A-4	--------	100	70-100	36-70	7-12	2. 0-6. 0	0. 15-0. 17	Low.
ML or CL	A-4 or A-6	--------	100	98-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low.
ML or CL	A-4 or A-6	--------	100	98-100	95-100	18-27	0. 6-2. 0	0. 20-0. 22	Low.
ML or CL	A-6 or A-4	100	100	98-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low.
CH	A-7	--------	100	99-100	98-100	40-52	0. 06-0. 2	0. 11-0. 13	High.
ML or CL	A-6 or A-4	100	100	98-100	95-100	18-27	0. 6-2. 0	0. 20-0. 22	Moderate.
ML or CL	A-4 or A-6	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low to moderate.
CH	A-7	--------	100	98-100	97-100	40-55	0. 06-0. 2	0. 11-0. 13	High.
ML or CL	A-4 or A-6	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 20-0. 22	Moderate.
CL or ML	A-6	100	100	98-100	90-100	18-27	0. 6-2. 0	0. 22-0. 24	Moderate.
CL	A-7 or A-6	100	100	98-100	95-100	27-35	0. 20-0. 6	0. 18-0. 20	Moderate to high.
CL	A-7 or A-6	100	100	98-100	95-100	27-35	0. 20-0. 6	0. 18-0. 20	Moderate.
CL	A-7 or A-6	100	100	98-100	95-100	27-35	0. 20-0. 6	0. 21-0. 23	Moderate to high.
CL	A-7 or A-6	100	100	98-100	95-100	27-35	0. 20-0. 6	0. 18-0. 20	Moderate to high.
CL	A-7 or A-6	100	100	98-100	95-100	27-35	0. 20-0. 6	0. 18-0. 20	Moderate.
ML or CL	A-6 or A-4	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Moderate.
CL	A-6 or A-7	100	100	97-100	97-100	27-35	0. 2-0. 6	0. 18-0. 20	Moderate.
ML or CL	A-6 or A-4	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low.
ML or CL	A-6 or A-4	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low to moderate.
CH or CL	A-7 or A-6	100	100	98-100	98-100	33-42	0. 2-0. 6	0. 18-0. 20	Moderate to high.
ML or CL	A-6 or A-4	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 20-0. 22	Low to moderate.
ML or CL	A-6	100	100	97-100	95-100	18-27	0. 6-2. 0	0. 22-0. 24	Low to moderate.
CH or CL	A-7 or A-6	100	100	99-100	98-100	33-42	0. 2-0. 6	0. 18-0. 20	Moderate to high.
ML or CL	A-6	100	100	95-100	90-100	18-27	0. 6-2. 0	0. 20-0. 22	Low.
SM or ML	A-4	100	100	85-100	36-55	3-18	2. 0-6. 0	0. 16-0. 18	Low.
SM or ML	A-4	100	100	85-100	36-55	3-18	2. 0-6. 0	0. 13-0. 15	Low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel	Depth from surface of typical profile	Classification: Dominant USDA texture
	Feet	*Feet*	*Inches*	
Hobbs: Hv, 2Hb	[3] 10–50	>10	0–45	Silt loam
			45–60	Silt loam
Holder:				
Hg, HgA, HgB, HgB2, HgC	>10	>10	0–10	Silt loam
			10–30	Light silty clay loam
			30–60	Silt loam
HgB3, HgC3	>10	>10	0–5	Silty clay loam
			5–19	Silty clay loam
			19–60	Silt loam
Hord: Hd, 2Hd, 2HdA	10–20	6–20	0–15	Silt loam
			15–50	Silt loam
			50–60	Silt loam
Inavale:				
Ig	5–20	[2] 1–2	0–12	Loamy fine sand
			12–60	Fine sand
In	5–20	[2] 1–2	0–12	Fine sandy loam
			12–60	Fine sand
Kenesaw: Ks, KsA, KsB, 2Ks	>10	[2] 5–20	0–8	Silt loam
			8–60	Silt loam
*Lex: LA	2–6	2–3	0–9	Silt loam
For Alda part, see Alda series.			9–22	Silt loam
			22–60	Coarse sand and gravel
Marsh: M. Properties too variable to be estimated.				
Meadin: Ms	15–50	1–2	0–9	Sandy loam
			9–60	Coarse sand and gravel
Platte: Pt	2–6	1–2	0–16	Loam
			16–60	Coarse sand and gravel
Riverwash: Rw. Properties too variable to be estimated.				
Rough broken land, loess: RB. Properties too variable to be estimated.				
Rusco: Ru	10–40	>10	0–8	Silt loam
			8–20	Silty clay loam
			20–60	Silt loam
Scott: Sc	>10	>10	0–6	Silt loam
			6–45	Silty clay
			45–60	Silt loam
Silty alluvial land: Sy. Properties too variable to be estimated.				
Spoil banks: S. Properties too variable to be estimated.				
*Thurman: TxB	20–50	[2] 5–8	0–18	Loamy fine sand
For Valentine part, see Valentine series.			18–60	Loamy fine sand
Valentine: VbC	30–70	[2] 2–5	0–5	Loamy fine sand
			5–60	Fine sand

[1] Where two or more classifications are shown, the classification listed first is considered to be the most common.
[2] Sand only.

significant to engineering—Continued

Classification—Continued		Percentage less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permea-bility	Available water capacity	Shrink-swell potential
Unified [1]	AASHO [1]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
						Percent	*Inches per hour*	*Inches per inch of soil*	
ML or CL	A-6 or A-4	100	100	95–100	95–100	18–27	0. 6–2. 0	0. 22–0. 24	Low to moderate.
ML or CL	A-4 or A-6	100	100	95–100	90–100	18–27	0. 6–2. 0	0. 20–0. 22	Low to moderate.
ML or CL	A-4 or A-6	100	100	97–100	95–100	18–27	0. 6–2. 0	0. 22–0. 24	Moderate.
CL	A-7 or A-6	100	100	97–100	97–100	27–35	0. 6–2. 0	0. 18–0. 20	Moderate.
ML or CL	A-4 or A-6	100	100	97–100	95–100	15–27	0. 6–2. 0	0. 22–0. 24	Low to moderate.
ML–CL, CL	A-7 or A-6	100	100	98–100	97–100	27–35	0. 2–0. 6	0. 21–0. 23	Moderate.
CL, ML–CL	A-7 or A-6	100	100	98–100	97–100	27–35	0. 2–0. 6	0. 18–0. 20	Moderate.
ML or CL	A-6	100	100	98–100	95–100	15–27	0. 6–2. 0	0. 20–0. 22	Low to moderate.
ML or CL	A-6 or A-4	100	100	95–100	90–100	18–27	0. 6–2. 0	0. 22–0. 24	Moderate.
ML or CL	A-6 or A-7	100	100	95–100	90–100	18–29	0. 6–2. 0	0. 20–0. 22	Moderate.
ML or CL	A-6 or A-4	100	100	95–100	90–100	18–27	0. 6–2. 0	0. 20–0. 22	Moderate.
SM	A-2	100	100	95–100	10–30	3–10	6. 0–20. 0	0. 10–0. 12	Low.
SM or SP–SM	A-3 or A-2	100	99–100	70–95	3–20	0–10	6. 0–20. 0	0. 05–0. 08	Low.
SM or ML	A-4	--------	100	95–100	30–55	10–18	2. 0–6. 0	0. 16–0. 18	Low.
SM, SP–SM, or SW	A-3 or A-2	100	99–100	71–96	3–20	0–10	6. 0–20. 0	0. 05–0. 08	Low.
CL or ML	A-6 or A-4	100	100	95–100	90–100	10–27	0. 6–2. 0	0. 22–0. 24	Low to moderate.
CL or ML	A-6 or A-4	100	100	95–100	90–100	10–27	0. 6–2. 0	0. 20–0. 22	Low to moderate.
ML or CL	A-6 or A-4	100	98–100	92–100	85–100	8–15	0. 6–2. 0	0. 22–0. 24	Low.
ML or CL	A-6 or A-4	100	98–100	88–100	85–100	12–18	0. 6–2. 0	0. 20–0. 22	Low.
SP–SM, SW, or SP–SC	A-1	90–100	80–100	5–50	0–8	0–5	>20. 0	0. 02–0. 04	Low.
SM, SC	A-2 or A-4	90–100	85–100	60–75	25–50	0–10	2. 0–6. 0	0. 13–0. 15	Low.
SP–SM or SW	A-1	90–100	85–100	5–50	0–8	0–5	>20. 0	0. 02–0. 04	Low.
CL or ML–CL	A-4 or A-6	90–100	85–100	60–100	51–75	7–20	0. 6–2. 0	0. 20–0. 22	Low.
SP–SM or SW	A-1	90–100	80–100	5–20	0–8	0–5	>20. 0	0. 02–0. 04	Low.
ML or CL	A-4 or A-6	100	100	97–100	90–100	18–27	0. 6–2. 0	0. 22–0. 24	Moderate.
CL	A-6 or A-7	100	100	97–100	95–100	27–35	0. 2–0. 6	0. 18–0. 20	Moderate.
CL or ML	A-6 or A-4	100	100	97–100	95–100	10–27	0. 6–2. 0	0. 20–0. 22	Low to moderate.
ML or CL	A-6	100	100	97–100	90–100	18–27	0. 6–2. 0	0. 22–0. 24	Low to moderate.
CH	A-7	100	100	99–100	97–100	40–55	<0. 06	0. 11–0. 13	High.
ML or CL	A-6	100	100	97–100	95–100	18–27	0. 6–2. 0	0. 20–0. 22	Moderate.
SM	A-2	100	100	95–100	10–30	3–10	6. 0–20. 0	0. 10–0. 12	Low.
SM	A-2	100	100	95–100	10–20	3–10	6. 0–20. 0	0. 08–0. 10	Low.
SM or SP–SM	A-2	100	100	95–100	10–20	3–10	6. 0–20. 0	0. 10–0. 12	Low.
SP or SP–SM	A-3 or A-2	100	100	95–100	3–10	3–10	6. 0–20. 0	0. 05–0. 08	Low.

[3] Seasonal high water table possibly within this range along the Little Blue River. In most areas of Hobbs soils, water table is at a depth of more than 50 feet.

TABLE 8.—*Interpretations of engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Suitability—					Soil properties affecting—	
	As source of—		Of material for—				
	Topsoil	Sand or mixed sand and gravel	Road subgrade: Paved surface	Road subgrade: Gravel surface	Road fill	Highway location	Foundations [1]
Alda. Mapped only in an undifferentiated group with Lex soils.	Good	Good for sand below a depth of 3 feet.	Good to fair.	Fair to poor.	Good to fair	Susceptibility to frost action; high water table; minimum fills required.	Good bearing capacity below a depth of 2 feet when confined; high water table.
Anselmo: 2An, 2AnA, 2Ap.	Good	Fair for sand below a depth of 3 feet.	Good where soil is sandy. Poor where soil is loamy or silty.	Fair	Good to fair.	Susceptibility to frost action; slopes subject to soil blowing and water erosion.	Good bearing capacity when confined.
Breaks-Alluvial land complex: By. No interpretations made; properties too variable.							
Butler: Bu	Good	(2)	Fair to poor.	Good to fair.	Fair to poor: high shrink-swell potential; compaction control needed.	Moderate susceptibility to frost action; surface ponding; minimum fills required in places; plastic subsoil is difficult to transport and place.	Fair to poor bearing capacity, depending on in-place density; surface ponding in places; may crack when dry.
Cass: Cs, Cm, 2Cm	Good	Fair for sand below a depth of 3 feet.	Good to fair.	Fair to poor.	Fair to good	Moderate to high susceptibility to frost action; slopes subject to soil blowing and water erosion.	Good to fair bearing capacity, depending on in-place density.
Coly: CbC, CbD	Good	(2)	Fair to poor	Good to fair.	Fair to poor	Susceptibility to frost action; slopes erodible; high cuts and fills needed because of topography.	Fair to poor bearing capacity, depending on in-place density; subject to consolidation upon wetting and loading.

See footnotes at end of table.

properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Good stability and workability; low compressibility; slopes erodible.	High water table; may be used for excavated ponds.	Slow internal drainage; high water table; suitable outlets not available in places.	Low available water capacity; high water table.	Diversion slopes erodible.	Erodible; medium to low in fertility.	Severe: may contaminate the underground water reservoir.	Severe: moderately rapid permeability, very rapid below a depth of 3 feet; high water table; sealing or lining needed to function.
Low compressibility; difficult to vegetate.	Seepage; requires sealing; dugouts feasible.	Rapid internal drainage.	Moderate available water capacity; subject to soil blowing and water erosion.	Highly erodible by water; hazard of soil blowing.	Erodible; maintenance costs may be high.	Moderate: may contaminate the groundwater.	Severe: moderately rapid permeability; sealing or lining needed to function.
Good to fair stability; fair workability; impervious; medium to high compressibility.	Low seepage; may be used for excavated ponds.	Slow internal drainage; surface ponding in places; suitable outlets not available in places.	High available water capacity; slow intake rate; adequate surface drainage necessary.	Diversion slopes erodible.	Erodible; water-tolerant grasses needed in places.	Severe: slow permeability; surface ponding in places.	Slight where excavations are less than 3.5 feet.
Fair stability and workability; close control required; toe drains needed in places.	Moderate seepage, but high if sand is exposed.	Rapid internal drainage; subject to occasional overflow in some areas.	Moderate available water capacity; protection from overflow needed in places.	Diversion slopes erodible; subject to overflow in places.	Erodible; low fertility in places; protection from overflow needed in places.	Slight: severe where subject to overflow.	Severe: moderately rapid permeability; protection from overflow required in places.
Fair stability; fair to good compaction if moisture is controlled; moderate compressibility.	Moderate seepage; sealing needed to hold water.	Medium internal drainage.	High available water capacity; erodible; unit CbD not suited.	Highly erodible; maintenance costs may be high because of siltation of channels.	Erodible; cuts; low fertility in places.	Moderate where slopes are less than 10 percent; severe where slopes are more than 10 percent: moderate permeability.	Severe: slopes; sealing or lining needed to function.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability— As source of— Topsoil	Suitability— As source of— Sand or mixed sand and gravel	Suitability— Of material for— Road subgrade: Paved surface	Suitability— Of material for— Road subgrade: Gravel surface	Suitability— Of material for— Road fill	Soil properties affecting— Highway location	Soil properties affecting— Foundations [1]
Crete: Ce	Good	(2)	Fair to poor	Good to fair.	Fair to poor: high shrink-swell potential.	Susceptibility to frost action; slopes erodible; plastic subsoil is difficult to transport and place.	Fair to poor bearing capacity, depending on in-place density.
Fillmore: Fm	Good	(2)	Fair to poor	Good to fair.	Fair to poor: high shrink-swell potential.	Susceptibility to frost action; occasional surface ponding; slopes erodible.	Fair to poor bearing capacity, depending on in-place density; surface ponding.
Geary: GeB2, GeC2, GsB, GsC, GsE.	Good where slopes are less than 8 percent. Fair where slopes are more than 8 percent.	Fair for sand below a depth of 10 feet.	Fair to poor.	Good	Fair to poor: moderate shrink-swell potential.	Susceptibility to frost action; slopes erodible; high cuts and fills needed because of topography.	Fair to poor bearing capacity, depending on in-place density; subject to consolidation upon wetting and loading; check density and moisture.
Hall: Ha	Good	(2)	Poor	Good	Fair: moderate shrink-swell potential.	Susceptible to frost action; slopes erodible; consolidation can be excessive for rigid structures.	Fair to poor bearing capacity, depending on in-place density.
Hastings: Hs, HsA	Good	(2)	Poor	Good	Fair: moderate shrink-swell potential.	Susceptible to frost action; slopes erodible; consolidation can be excessive for rigid structures.	Fair to poor bearing capacity, depending on in-place density.
Hastings, thin solum, variant: 2Hs.	Good	(2)	Poor	Good	Fair: moderate shrink-swell potential.	Susceptible to frost action; slopes erodible; consolidation excessive in places when wetting and loading occur.	Fair to poor bearing capacity, depending on in-place density.

See footnotes at end of table.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Fair to good stability; impervious; fair to poor workability; moderate compressibility.	Low seepage	Slow internal drainage.	High available water capacity; slow intake rate.	Moderately erodible.	Erodible; subsoil low in fertility.	Severe: slow permeability above a depth of 2 feet; moderate permeability below a depth of 2 feet.	Slight where cuts are less than 2 feet; sealing or lining needed where cuts are more than 2 feet.
Good to fair stability; fair to poor workability; impervious; slopes erodible.	Low seepage; may be used for excavated ponds.	Slow internal drainage; subject to ponding; suitable outlets not available in places.	High available water capacity; slow intake rate; adequate surface drainage needed.	Diversion slopes erodible.	Erodible; water-tolerant grasses needed in places.	Severe: slow permeability; surface ponding.	Slight where excavations are less than 4 feet.
Good to fair stability and workability; impervious; slopes erodible.	Low seepage	Medium internal drainage.	High available water capacity; erodible.	Moderately erodible.	Erodible; subsoil low in fertility.	Moderate where slopes are less than 10 percent. Severe where slopes are more than 10 percent: moderately slow permeability.	Moderate where slopes are 2 to 7 percent. Severe where slopes are more than 7 percent: seepage slight in compacted soil.
Good to fair stability and workability; requires compaction control.	Low to moderate seepage.	Medium to slow internal drainage.	High available water capacity.	Diversion slopes erodible.	Erodible	Moderate above a depth of 3.5 feet: moderately slow permeability. Slight below a depth of 3.5 feet.	Slight for compacted soil above a depth of 3.5 feet.
Good to fair stability and workability; medium compressibility; impervious.	Low seepage above a depth of 3.5 feet.	Medium to slow internal drainage.	High available water capacity.	Moderately erodible.	Erodible	Moderate above a depth of 3.5 feet: moderately slow permeability. Slight below a depth of 3.5 feet.	Slight for excavations of less than 3.5 feet; slight for compacted soils.
Good to fair stability and workability; medium compressibility; impervious.	Low to moderate seepage.	Medium to slow internal drainage.	High available water capacity.	Moderately erodible.	Erodible	Moderate above a depth of 2 feet: moderately slow permeability. Slight below a depth of 2 feet.	Slight for compacted soils above a depth of 2 feet; sealing or lining needed for cuts of more than 2 feet.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability— As source of— Topsoil	Suitability— As source of— Sand or mixed sand and gravel	Suitability— Of material for— Road subgrade: Paved surface	Suitability— Of material for— Road subgrade: Gravel surface	Suitability— Of material for— Road fill	Soil properties affecting— Highway location	Soil properties affecting— Foundations [1]
*Hersh: HmB, HR. For Kenesaw part of HR, see Kenesaw series.	Fair	Fair for sand below a depth of 5 feet.	Fair to poor.	Good to fair.	Good to fair: adequate compaction control required.	Moderate susceptibility to frost action; high cuts and fills needed because of topography.	Fair to good bearing capacity when confined.
Hobbs: Hv, 2Hb	Good	([2])	Fair to poor.	Good to fair.	Fair to poor	Susceptible to frost action; slopes erodible; subject to overflow; minimum fills required in some places.	Fair to poor bearing capacity, depending on in-place density.
Holder: Hg, HgA, HgB, HgB2, HgB3, HgC, HgC3.	Good	([2])	Fair to poor.	Good to fair.	Fair	Susceptible to frost action; slopes erodible; requires high cuts and fills in places because of topography; subject to excessive consolidation.	Good to fair bearing capacity, depending on in-place density; consolidation may be excessive when wetted and loaded.
Hord: Hd, 2Hd, 2HdA	Good	([2])	Fair to poor.	Good to fair.	Fair	Susceptible to frost action; slopes erodible; compaction control required.	Good to fair bearing capacity, depending on in-place density.
Inavale: Ig, In	Poor	Fair for sand; poor for gravel.	Good	Poor	Good: needs flatter slopes and erosion control.	Low susceptibility to frost action; slopes subject to soil blowing and water erosion; check depth to water.	Good bearing capacity if confined; low areas subject to overflow.

See footnotes at end of table.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Fair stability; low compressibility; difficult to vegetate.	High seepage; sealing or lining needed to hold water.	Rapid internal drainage.	Moderate available water capacity.	Highly erodible by water; hazard of soil blowing; irregular topography makes alinement difficult.	Erodible; maintenance costs high in places.	Slight: irregular topography in some places.	Severe: moderately rapid permeability; sealing or lining required for proper functioning.
Good stability and workability; requires compaction control; slopes erodible.	Moderate seepage.	Medium internal drainage; subject to occasional overflow in some areas.	High available water capacity; needs protection from overflow in places.	Moderately erodible; subject to overflow in places.	Erodible; protection from overflow needed in places.	Moderate: moderate permeability. Severe where soil is subject to overflow.	Severe: sealing or lining needed to function; protection from overflow needed.
Fair stability and workability; moderate compressibility; impervious; slopes erodible.	Low seepage above a depth of 2 to 3 feet.	Generally medium internal drainage.	High available water capacity; erodible.	Moderately erodible.	Erodible	Moderate where slopes are less than 10 percent. Severe where slopes are more than 10 percent: moderate permeability.	Moderate where slopes are 2 to 7 percent. Severe where slopes are more than 7 percent.
Good stability and workability; requires compaction control; impervious slopes erodible.	Low seepage for compacted soils.	Medium internal drainage.	High available water capacity.	Moderately erodible.	Erodible	Moderate: moderate permeability where not compacted.	Moderate: moderate permeability; compaction or sealing required to function.
Good stability and workability; slopes subject to soil blowing and water erosion.	High seepage, except for high water table; dugouts feasible.	Rapid internal drainage; subject to overflow in low areas.	Low available water capacity; rapid intake rate; subject to soil blowing and water erosion.	Diversion slopes erodible.	Erodible; droughty; lacks fertility in places.	Slight: moderate if subject to overflow and possibility of contaminating the underground water.	Severe: rapid permeability; subject to overflow; diking and lining is feasible.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability— As source of— Topsoil	Suitability— As source of— Sand or mixed sand and gravel	Suitability— Of material for— Road subgrade: Paved surface	Suitability— Of material for— Road subgrade: Gravel surface	Suitability— Of material for— Road fill	Soil properties affecting— Highway location	Soil properties affecting— Foundations [1]
Kenesaw: Ks, KsA, KsB, 2Ks.	Good	Check site for sand below a depth of 5 to 6 feet.	Fair to poor.	Good to fair.	Fair: compaction control required.	Susceptible to frost action; slopes erodible; requires high cuts and fills in places because of topography; subject to excessive consolidation.	Good to fair bearing value, depending on in-place density.
*Lex: LA. For Alda part, see Alda series.	Good	Good below a depth of 2 feet.	Good below a depth of 2 feet.	Good above a depth of 2 feet.	Good: use sand in center of fill.	Moderate susceptibility to frost action; high water table; requires minimum fill; slopes erodible.	Good bearing capacity below a depth of 2 feet when sand is confined; high water table.
Marsh: M. No interpretations made; properties too variable.							
Meadin: Ms	Poor	Good	Good	Poor	Good	Low susceptibility to frost action; slopes erodible; special earth-moving equipment needed in places.	Good bearing capacity if confined; excavations need bracing.
Platte: Pt	Fair	Good for sand.	Good below a depth of 1.5 feet.	Good above a depth of 1.5 feet.	Fair in surface layer. Good below a depth of 1.5 feet; high water table.	Low susceptibility to frost action; high water table; minimum fills required; subject to overflow in some areas; fill slopes erodible.	Good bearing capacity if confined; high water table; subject to overflow in some areas.
Riverwash: Rw.[3]							
Rough broken land, loess: RB. No interpretations made; properties too variable.							

See footnotes at end of table.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Fair stability; moderate compressibility; compaction control required; slopes erodible.	Moderate seepage with compaction of soil; excessive seepage for cuts of more than 5 to 6 feet.	Medium internal drainage.	High available water capacity; erodible.	Highly erodible; irregular topography makes alinement difficult; maintenance costs high in places because of siltation of channels.	Erodible; lacks fertility in places.	Moderate where slopes are less than 10 percent: moderate permeability.	Severe: slopes; moderate permeability; sealing or lining needed to function.
Good stability and workability; moderate compressibility; slopes erodible; high water table.	High water table; can be used for dugouts.	Slow internal drainage; high water table.	Low available water capacity; adequate drainage needed.	Diversion slopes erodible.	Erodible; lacks fertility in places.	Severe: high water table; contamination of underground water certain.	Severe: high water table; diking and lining feasible in places; check each site.
Good stability and workability; slopes erodible; pervious.	High seepage; water table too deep for dugouts in places.	Very rapid internal drainage.	Low available water capacity; rapid intake rate; subject to soil blowing.	Diversion slopes erodible.	Erodible; low fertility; droughty.	Slight: possible contamination of the underground water.	Severe: very rapid permeability in underlying sand and gravel; constructed liner needed to insure proper functioning.
Good stability; compaction control required; good workability; low compressibility; slopes subject to soil blowing and water erosion; needs seepage control.	High seepage; high water table; can be used for dugouts.	Slow internal drainage; high water table; subject to overflow in some areas.	Low available water capacity; adequate drainage required; protection from overflow needed in places.	Diversion slopes erodible.	Erodible; medium to low fertility; water-tolerant grasses required; droughty on surface in places.	Severe: moderate permeability above a depth of 2 feet; high water table; subject to overflow in some areas; contamination of underground water possible.	Severe: very rapid permeability below a depth of 2 feet; possible flooding; diking and lining needed for proper functioning.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability— As source of— Topsoil	Suitability— As source of— Sand or mixed sand and gravel	Suitability— Of material for— Road subgrade: Paved surface	Suitability— Of material for— Road subgrade: Gravel surface	Suitability— Of material for— Road fill	Soil properties affecting— Highway location	Soil properties affecting— Foundations [1]
Scott: Sc	Good if not ponded.	[2]	Fair to poor.	Good	Fair to poor: high shrink-swell potential.	Moderate susceptibility to frost action; frequent surface ponding; minimum fills required.	Fair to poor bearing capacity, depending on in-place density; frequent surface ponding.
Silty alluvial land: Sy.[4]							
Spoil banks: S. No interpretations made; properties too variable.							
*Thurman: TxB. For Valentine part, see Valentine series.	Poor	Good for fine sand below a depth of 5 feet.	Good if well compacted.	Poor	Good: suitable compaction needed.	Low susceptibility to frost action; slopes subject to soil blowing and water erosion; unstable unless confined.	Good bearing capacity if confined.
Valentine: VbC	Poor	Good for fine sand below a depth of 2 feet.	Good if well compacted.	Poor	Good: adequate compaction control needed.	Low susceptibility to frost action; slopes subject to soil blowing; high cuts and fills required because of topography; unstable unless confined.	Good bearing capacity if confined.

[1] Engineers and others should not apply specific values to interpretations of bearing capacity in this column.
[2] Unsuitable; generally not available.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Good stability; fair workability; impervious; slopes erodible; surface ponding is feasible.	Low seepage; can be used for excavated ponds.	Very slow internal drainage; subject to frequent ponding; suitable outlets not available in places.	High available water capacity; slow intake rate; adequate surface drainage required.	Diversion slopes erodible.	Erodible; water-tolerant grasses required.	Severe: very slow permeability; frequent surface ponding.	Moderate: protection from surface ponding needed.
Good stability; good workability; low compressibility; pervious; slopes subject to soil blowing and water erosion.	High seepage	Rapid internal drainage, excessive in places.	Low available water capacity; rapid intake rate; highly subject to soil blowing and water erosion.	Highly subject to soil blowing and water erosion; irregular topography makes alinement difficult.	Erodible; droughty; low fertility.	Slight: trenches subject to caving.	Severe: rapid permeability; constructed lining needed to function properly.
Good stability and workability; low compressibility; pervious; slopes subject to soil blowing and water erosion.	High seepage	Rapid internal drainage, generally excessive.	Low available water capacity; rapid intake rate; highly subject to soil blowing and water erosion.	Highly subject to blowing and water erosion; irregular topography makes alinement difficult.	Erodible; low fertility; droughty.	Slight for slopes of less than 5 percent; moderate where slopes are 5 to 10 percent; severe where slopes are more than 10 percent: trenches subject to caving.	Severe: rapid permeability; slopes; constructed liner needed to function properly.

[3] This land type is a poor source for topsoil and a good source for sand or mixed sand and gravel; other properties are too variable to be estimated.

[4] This land type is a fair source for topsoil; other properties are too variable to be estimated.

The estimates in table 7 are based on the engineering test data in table 6 and on other information obtained in the county during the survey. The data are listed by strata that have properties significant to engineering. These data include the textural classification of the U.S. Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass a No. 4 sieve, a No. 10 sieve, a No. 40 sieve, a No. 200 sieve, and the percent finer than 0.002 millimeter as determined by the hydrometer method. Estimates of the percentage passing the sieves are based on the assumption that material up to and including 3 inches in diameter equals 100 percent. There are no soils in Adams County that have a significant percentage of coarse materials greater than 3 inches.

In the AASHO and Unified systems, soil particles retained on the No. 200 sieve are classed as sand and gravel. Silt and clay particles will pass through this sieve. Particles retained on the No. 4 sieve are classed as gravel. The range of values shown in table 7 for the percentage of soil finer than 0.002 millimeter represents the estimated clay fraction of the soil. Silt and clay particles affect such properties as strength, permeability, compaction, and shrink-swell potential.

In tables 6 and 7, the percentage of clay is based on an analysis that uses the hydrometer method (AASHO Designation T–88). This can give results that differ slightly from those obtained with the pipette method used by SCS soil scientists to obtain results with standard soil survey procedures.

In table 7, permeability refers to the rate at which water moves through a saturated soil. It depends largely on gradation, structure, and density. The rate is given in inches of water per hour. Rates are given for the major significant soil horizons. Terms used to describe permeability and the equivalent rates are defined in the Glossary.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. In the table it is expressed as inches of water per inch of soil.

Soil dispersion is not a serious problem in the county, because only a few areas contain enough salts to produce moderate dispersion. Salinity generally is not a problem.

A generalized rating for shrink-swell potential is given in table 7. Several soils, such as those in the Hastings, Crete, and Fillmore series, have moderate to high shrink-swell potential. Generally, soils that have high content of expandable clay, such as montmorillonite, undergo a volume change when the soil moisture is changed. Clean sand and gravel undergo little or no volume change when wetting or drying occurs.

Reaction of a soil is the degree of acidity or alkalinity, expressed as a pH value or reaction class. A soil with a value of 7.0 is neutral, one with a lower value is acid, and a soil with a pH greater than 7.0 is alkaline. Reaction is not given in table 7. In Adams County, soil materials having an approximate pH value of more than 7.8 or less than 6.3 need to be investigated for the potential corrosion they may cause to metal structures. The reaction class for most horizons of the representative profile is given in the section "Descriptions of the Soils." Soils used as construction materials, when moist or wet, need to be tested for corrosion potential.

Engineering interpretations of the soils

Table 8 indicates general interpretations of the soils for their use in engineering. These interpretations are best used as a guide for planning more detailed investigation. They cannot replace onsite investigation of specific tracts of land.

In table 8, topsoil is rated *good*, *fair*, or *poor*, depending on depth, fertility, content of organic matter, erodibility, workability, and quantity. Topsoil is used to cover road and dam embankments, excavated slopes, and gardens and lawns.

Several soils in Adams County are a source of sand or sand and gravel. Meadin, Lex, and Platte soils are examples of soils that are a source of sand. Exploration is needed to determine quantity and gradation and depth to the sand and gravel. Operational sandpits are a guide to locating sources of sand and gravel.

Ratings for use of soil as road fill are based on suitability of the soil as embankments, its suitability as a foundation for embankments, the erodibility of cut slopes, and the potential frost action. Sands and gravels are rated *good* to *fair* for subgrades under pavement and *poor* for gravel-road subgrades. Silt and clay on the road subgrade surface are more stable for gravel surfacing. Thus, for paved roads, soils having an AASHO classification of A–1 and A–3 are rated *good;* A–2, *good* to *fair;* A–4, *fair* to *poor;* and A–6 or A–7, *poor*. For most soils the road subgrade (foundation) and road fill use the same classification for paved roads because the engineering requirements are approximately the same.

Among the soil properties that affect highway location are susceptibility to frost action, shrink-swell potential, erodibility of cut and fill slopes, possible flooding, and location of water table. Frost action is caused by the expansion of freezing water in silt-clay soils, and this, in turn, increases maintenance of paved roads. A high water table can contribute to potential frost action or frost heave.

An important soil property that affects foundations is bearing, or load-carrying, capacity. Most soils have a high bearing capacity when dry. Some of the windblown soils are subject to high consolidation when saturated under load. Sand and gravel have high bearing capacity when confined. Specific values for bearing capacity should not be assigned to estimated values as expressed in words in table 8. Wet excavations for buildings may be a limitation. Depth to water, therefore, should be determined for building sites. The shrink-swell potential given in table 7 is important to foundations. The possibility of seepage into foundations or excavations is indicated.

Embankments are subject to seepage and compressibility. These factors are rated in table 8. Workability includes hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Erodibility of fill slopes is also described. Two methods of compaction are required for soils in Adams County. Refer to table 6 for test results that give maximum dry density for particular samples. Soils containing approximately 15 percent or less of silt and clay particles should have compaction controlled by the relative density test. This test is equivalent to the use of vibratory rollers rather than sheepsfoot rollers. Soils containing approximately 15 percent or more of silt and clay particles are generally compacted with sheepsfoot, or tempering, roll-

ers, and moisture is controlled at or above a minimum limit.

Dikes and levees are used to control surface water. They are subject to erosion by wind and water and are subject to horizontal seepage if they are not properly compacted or if they are constructed of clean sand. Some soils are subject to shrinkage and cracking when they dry. Dikes and levees constructed with sandy soils need flat slopes for stability. Steeper slopes are used for dikes and levees constructed with clay soils because the fill is relatively impervious to water.

For farm ponds, potential seepage in the soil and the use of soil for embankments is described in table 8. A high water table indicates the possibility of excavating a dugout for a water supply. A deep water table may indicate the need for sealing or lining a pond; it also indicates that construction of a fill may be easier because the foundation is drier.

Agricultural drainage, as shown in table 8, is affected by depth to the water table, availability of outlets, and permeability of the various soil layers.

Suitability of soils for irrigation is affected by such properties as the available water capacity, permeability, rate of water intake, steepness of slope, and possible limiting depth of leveling cuts.[7] The ratings for available water capacity are limited to the top 5 feet of soil. The capacity is *high* if the soil holds more than 9 inches of water; *moderate* if the soil holds 6 to 9 inches; *low* if the soil holds 3 to 6 inches; and *very* low if the soil holds less than 3 inches.

Intake rate is the rate of movement of water into the soil. This rate is affected by the permeability of the various soil layers being irrigated. The intake rates are given for some soils in table 8, and a permeability range is given in table 7. The intake rate is *rapid* if the soil takes in more than 2 inches of water per hour; *moderate* if the rate is from 0.5 to 2 inches per hour; and *slow* if the rate is less than 0.5 inch per hour.

Use of the soils for terraces, diversions, and grassed waterways is affected by the possible loss of soil material through soil blowing and water erosion, difficulty of establishing vegetation, and the fertility of the soil. Maintenance costs of terraces and diversions are greater where siltation occurs from higher elevations. Depth to erodible sands will limit the depth of cuts for diversion alinement. Rough topography and steep slopes are factors in terrace and diversion alinement.

For sewage disposal, the limitations to use of the soils for sewage filter fields and sewage lagoons are given in table 8. Use of soils for sewage disposal can also be related to information given in table 7, including the engineering classifications, values for permeability, and available water capacity. For filter fields, soil limitations are rated as slight, moderate, or severe. *Slight* indicates good infiltration without contaminating the underground water; *moderate* indicates a finer grained soil that has a lower intake rate; and *severe* indicates a high water table or an impervious soil.

For sewage lagoons, water must be retained in the lagoon for aerobic decomposition of the fresh sewage to occur. Thus, an impervious soil is desired for constructing this facility. The probability of a soil requiring sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner is indicated. A soil may have potential for being reworked and compacted to provide a liner. A lagoon constructed in sandy material with a high water table would be the least desirable sewage disposal facility. A sewage filter field or disposal lagoon needs to be located so as not to contaminate wells that furnish the domestic water supply or stockwater. Other factors, such as steepness of slope and possibility of flooding, need to be considered in design of sewage treatment facilities.

[7] Further information on the irrigation of soils is contained in the "Nebraska Irrigation Guide."

Formation and Classification of the Soils

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Adams County. The second explains the system of soil classification currently used and places each soil series in some of the categories of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The soils of Adams County formed in three kinds of parent material—loess, eolian sands, and alluvium. The principal parent material is loess. Peoria loess, which is most extensive, is light-gray to very pale brown, calcareous silt loam. Its thickness ranges from a few feet to as many as 25 feet or more. The well-drained to somewhat excessively drained, friable soils of the uplands that formed in this loess are the Coly, Hall, Hastings, Holder,

and Hord. The moderately well drained to somewhat poorly drained claypan soils on uplands are the Butler and Crete soils. Poorly drained claypan soils in upland depressions are the Fillmore and Scott soils.

Below the Peoria loess is the Loveland loess, which consists of reddish-brown silt and silty clay. It underlies the Peoria loess and is at the surface on the lower slopes of hillsides along the Little Blue River and along many of the intermittent drainageways. The friable, well-drained to somewhat excessively drained Geary soils formed in Loveland loess.

In the western part of the county is an area of reworked Peoria loess. The loess was eroded, reworked, and redeposited as eolian silt during the period when the Sandhill areas in western Adams County were formed. The resulting parent material ranges from silt loam to loam and has lenses of sand. Topography over much of the area is hummocky. The soils that formed in this material are the well drained Kenesaw soils and the moderately well drained to somewhat poorly drained Rusco soils in run-in areas or depressions.

The deep, sand soils on uplands in western Adams County formed in eolian sand. The topography of the area is hummocky, and the hummocks range from 2 to 15 feet in height. The sand, which is not uniformly distributed, ranges from 2 to about 50 feet in thickness and is mixed with loess in some places. Soils that formed in eolian sand mixed with loess are the well-drained Hersh soils. The somewhat excessively drained to excessively drained Thurman and Valentine soils formed in loose eolian sand.

Recent alluvium is on stream terraces and bottom lands along the major drainageways. It consists of sediment washed from the uplands onto the flood plains. Soil formation is slight in the alluvial sediment, and the texture of the soil is closely related to the texture of its parent material.

The alluvium on most of the stream terraces is silty, and some of it has been covered with loess. The well-drained Hord soils formed in this material. On stream terraces along the Platte River, 1 to 5 feet of alluvium has been deposited over sand and gravel. Deep, well-drained soils that formed in alluvium of sandy loam texture are the Anselmo soils. Soils that formed in loamy material 10 to 20 inches thick over sand and gravel are the Meadin soils, and they are excessively drained.

The most recent alluvium is along small upland drainageways where fresh material is being deposited. On bottom lands along Cottonwood Creek and the Little Blue River, 1 to 3 feet of loamy alluvium overlies sandy alluvium. The alluvium on bottom lands along Sand Creek is sandy.

The deep bottom-land soils that formed in alluvium of silt loam texture are the well-drained Hobbs soils; those that formed in alluvium of sandy loam texture are the well-drained Cass soils; and those that formed in alluvium of loamy sand or sand texture are the excessively drained Inavale soils. Bottom lands along the Platte River have alluvium deposited 1 to 5 feet thick over sand and gravel. Lex soils formed in alluvium of silt loam texture that was deposited 20 to 40 inches thick over sand and gravel; Alda soils formed in alluvium of fine sandy loam texture deposited 20 to 40 inches thick over sand and gravel; and Platte soils formed in loamy alluvium deposited 10 to 20 inches thick over sand and gravel. Lex, Alda, and Platte soils are affected by a water table that fluctuates between 2 and 6 feet below the surface, and they are all somewhat poorly drained.

A basal deposit of coarse sand or mixed sand and gravel underlies the entire county. Small outcrops are common on the lower hillsides along some of the major streams. No bedrock formations are exposed in the county. Figure 23 shows the relationship between parent material, topography, and drainage in Adams County.

Climate

Adams County has a continental climate marked by wide seasonal variations in temperature and precipitation. Climate is fairly uniform throughout the county, and difference in soils cannot be attributed to climate. Temperatures below 0°F. in winter and above 100° in summer are common. The mean annual temperature is 51°, and the average annual rainfall is 26.6 inches. The average growing season is about 160 days. If moisture is sufficient, frost penetrates to a depth of 2 to 4 feet in winter.

Climate affects weathering and soil formation directly through rainfall, changes in temperature, and the working of wind. In this county percipitation is not heavy enough to leach the soils deeply. Leaching is normally limited to the upper 3 or 4 feet, except in the sandy soils, some of which are leached much deeper. As water moves through the soil, it carries nutrients, clay, and organic matter from the surface horizon to the subsoil or underlying layers.

The flow of surface water caused by heavy rains continuously detaches, mixes, transports, and redeposits unconsolidated material of all kinds. The alluvial soils are examples of soils that formed in sediment deposited by water.

The chemical processes and activities of micro-organisms are influenced by temperature. Alternate freezing and thawing, and wetting and drying, speed the mechanical and chemical weathering processes and also improve the physical condition of the soil.

Wind transfers soil material from one place to another. The extensive deposits of loess are examples of the importance of wind as an agent in the deposition of soils in the county. The gently rolling topography of the Holder and Hastings soils and the hummocky topography of the Hersh, Kenesaw, Valentine, and Thurman soils can be attributed to wind activity.

Climate also plays a major role in determining the kind and amount of plant and animal life that can be sustained. The primary source of organic matter in a soil is vegetation.

Plant and animal life

When the weathering and deposition processes slow down, grasses and other plants take root. As soon as vegetation is established, many kinds of animals and organisms inhabit the soil material to make use of the food provided by the plant. Plants and animals are most important in developing the chemical and physical characteristics of a soil.

The soils in Adams County formed under tall, mid, and short grasses. The fibrous roots of grass penetrate the soil to a depth of several feet and improve porosity and

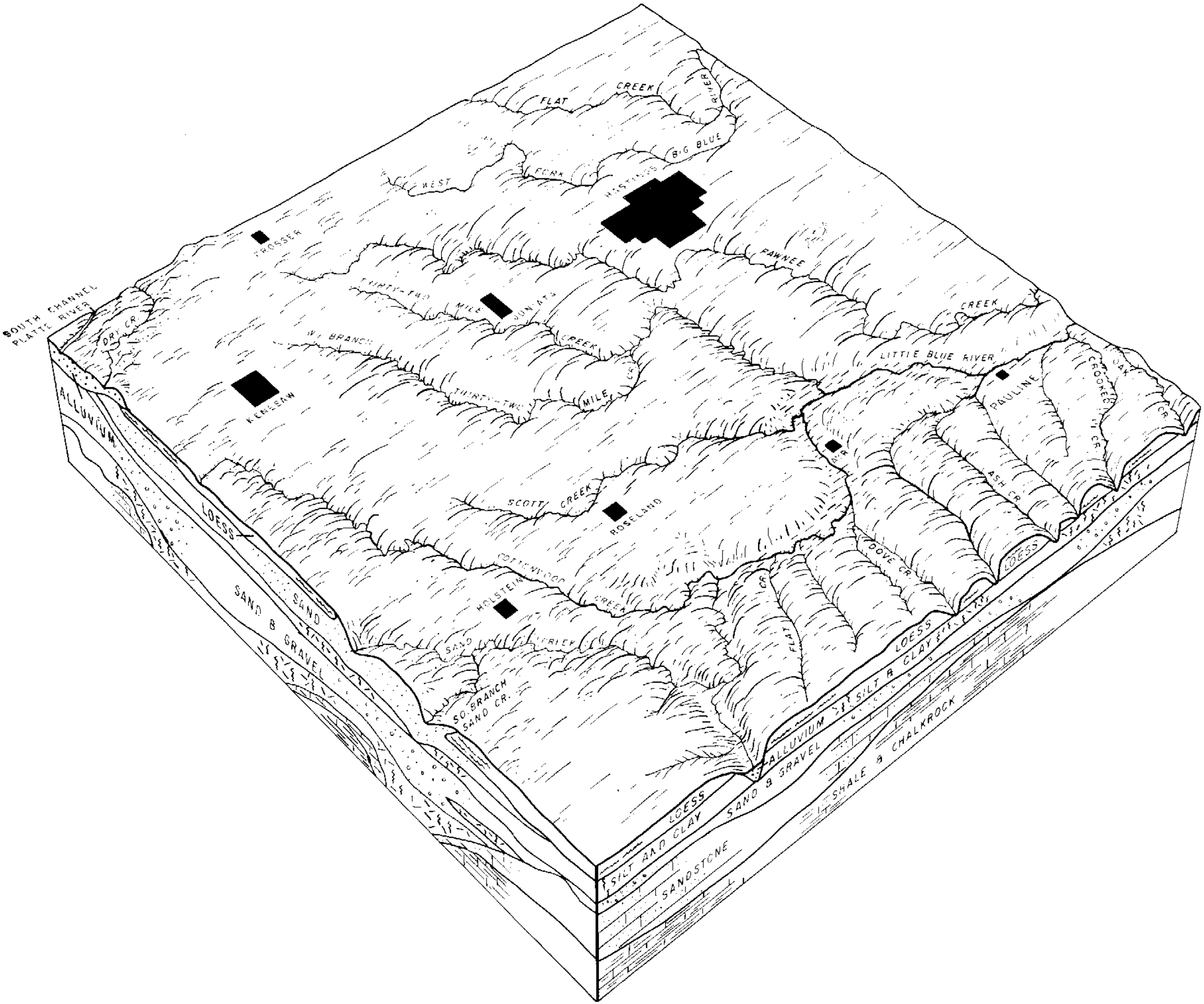


Figure 23.—**Parent material, topography, and drainage pattern of Adams County.**

structure of the soil. Plant roots bring nutrients from the lower part of the soil and return them to the surface layer as part of the organic matter. As the old roots die, new ones take their place. The decay of grass roots and leaves to form organic matter and humus improves the fertility, the physical and chemical composition, and the available water capacity of the soil.

Dead roots and undecomposed organic matter are attacked by micro-organisms to produce humus and other mineral nutrients that are available to living plants. Some bacteria take nitrogen from the air and use it for their own growth. When the bacteria die, the nitrogen is available for use by plants. Insects, earthworms, and small burrowing animals help to mix humus with the soil. Their burrowing activities stir the soil and mix it with fresh nutrients, and this hastens the formation of organic matter.

Relief

Relief, or lay of the land, influences soil formation through its effect on runoff and drainage. It influences the development of soils in relatively small areas, chiefly by controlling the movement of water on the surface. The degree of slope, the shape of the surface, and other features of relief affect each soil that develops. Relief influences the moisture content in soils and the erosion from their surface.

Steep soils have a thin surface layer and indistinct horizons. The steep slopes cause rapid runoff, so that only a small amount of water enters the soil. Plants grow slowly, and soil formation proceeds slowly. If there is too much runoff, the surface layer may be removed as fast as it forms. Lime is not deeply leached in soils that have steep slopes.

Except for the Kenesaw soils, most of the nearly level to strongly sloping soils that formed in loess on uplands have well-developed profile characteristics. Relief affects these soils by the amount of runoff and erosion that occurs. Normally, as the degree of slope increases, the thickness of the soil profile decreases. Low and flat topography means that extra water is added to the soil. The extra moisture is reflected in a thick, dark-colored surface layer, more horizon development, and more leaching of lime. In nearly level areas or in depressions where there is little or no runoff, a claypan may develop in the subsoil.

Soils on bottom lands and low stream terraces have very little relief. The deposits have been in place for such a short period that relief has had little effect. Some soils on bottom lands have a high water table that affects the decay of organic material, soil temperature, and alkalinity. Other bottom-land soils are subject to flooding, and there is continuous deposition of sediment.

Time

Time is required for soil formation. How much time depends mainly on the kind of parent material. If the factors of soil formation have not operated long enough to form a soil that is in equilibrium with its environment, the soil is considered young or immature. The older soils have reached an equilibrum with their environment. If the land use, irrigation, or some other factor changes the environment, the soil establishes a new equilibrum to meet the new environment.

The soils in Adams County formed in unconsolidated materials. They range from young soils that have little or no development to old soils that have a thick profile and pronounced development. The Loveland loess was deposited first and is the oldest loess parent material in the county. The Peoria loess covered the Loveland loess until geologic erosion re-exposed the Loveland material on some of the lower slopes. The soils that formed in Loveland and Peoria loess have been in place long enough for genetic profiles to have developed and for horizons to have accumulated some thickness.

The eolian silt and sand in the western part of the county have not been in place long enough for mature soils to develop. Soils in these deposits are young, immature, and have little horizon development.

The alluvial soils are the youngest soils in the county. These soils have little or no subsoil development, because of the brief time their parent materials have been in place. In areas subject to flooding, deposition is still occurring.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (*4*, *6*). In table 9, the soil series of Adams County are placed in some categories of the current system (1972). The placement of some soil series in the system, particularly the placement in the families, may change as more precise information becomes available.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measureable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Alda	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Anselmo	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Cass [1]	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Coly	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Crete [2]	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Geary [3]	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hastings, thin solum variant.	Fine, montmorillonitic, mesic	Typic Argiustolls	Mollisols.
Hersh	Coarse-loamy, mixed, nonacid, mesic	Typic Ustorthents	Entisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holder [4]	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Kenesaw	Coarse-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Lex	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic.	Typic Haplaquolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Platte	Sandy, mixed, mesic	Mollic Haplaquents	Entisols.
Rusco	Fine-silty, mixed, mesic	Aquic Argiustolls	Mollisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Thurman	Sandy, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.

[1] Cass soils in mapping unit Cs are taxadjuncts to the Cass series because the A horizon is thinner than the range defined for the series.
[2] Crete soils in Adams County are taxadjuncts to the Crete series because they have mollic epipedons less than 20 inches thick.
[3] Geary soils in mapping units GeB2 and GeC2 are taxadjuncts to the Geary series because they lack mollic epipedons.
[4] Holder soils in mapping units HgB2; HgB3 and HgC3 are taxadjuncts to the Holder series because they lack mollic epipedons.

exceptions, the Entisols and Histosols, occur in many different kinds of climate. The two soil orders in Adams County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or have only the beginnings of such horizons.

Mollisols formed under grass and have a thick, dark-colored surface layer that contains colloids dominated by bivalent cations.

SUBORDER.—Each order has been divided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS.—Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in their arrangement within the profile. They are generally given the name of a geographic location near the place where that series was first observed and mapped.

Physical and Chemical Analyses

Data obtained by laboratory analyses for two profiles of Hastings soils in Adams County are given in Soil Survey Investigations Report No. 5 (*9*). Other data from profiles sampled in adjacent or nearby counties also are reported in this publication for soils of the Anselmo, Cass, Crete, Hall, Hastings, Hord, Kenesaw, Thurman, and Valentine series. Physical and chemical analyses, clay mineralogy, and other information on the Hastings series are available in a published report entitled "Hastings Soils" (*2*). Laboratory data for soils of the Cass, Fillmore, Hall, Hord, Kenesaw, Platte, Thurman, and Valentine series are available in the soil survey of Hall County, Nebraska (*8*).

General Nature of the County

This section was prepared mainly for those not familiar with Adams County. It contains subsections on early history and settlement, relief and drainage, water supply, transportation and markets, climate, and farming.

Early History and Settlement

In 1841, settlers heading for the Oregon country made a wide path across Adams County from southeast to northwest known as the Oregon Trail. Although the Oregon Trail was not a major factor in the settlement of Adams County, it was an important part of the county's history. The Oregon Trail has been all but obliterated, but markers throughout the county still identify the trail and some of the historic sites.

Adams County was organized in 1871, and Juniata was designated the county seat. Settlement came with the westward advance of the Burlington and Missouri River Railroad, now owned by the Burlington Northern Railroad. It was given added impetus with the arrival of a second railroad, the St. Joseph and Denver City Railroad, now owned by the Union Pacific. Hastings was established in 1872 at the point where the two railroads crossed. Hastings grew rapidly, and in 1878 the county seat was moved to Hastings. Kenesaw was established in 1872, Ayr in 1878, and Hansen in 1879. The building of the Kansas City and Omaha Railroad across the southern part of the county in 1887 brought the founding of Pauline, Roseland, and Holstein. Prosser was founded in 1888, when the Missouri Pacific Railroad chose to end its branch line at the site northwest of Hastings.

The great bulk of homestead land was nearly all taken up between 1870 and 1880. By 1880, homesteaders of Adams County dotted the prairie with their dwellings. The 1880's were days of great promise. Farmers prospered and prices soared. Then came the 90's and the drought and grasshoppers. Farmers left their land, and the eastward bound caravans of wagons rivalled those of the westward migrations of earlier years. At the turn of the century, there was rain and better crops. New settlers replaced those that left. Soon a war in Europe brought high prices and great prosperity.

The population of Adams County increased from 29 in 1871 to 26,275 by 1930. In 1970 there were 30,184 residents in the county.

Relief and Drainage

Adams County lies within the Loess Plains, a part of the Great Plains physiographic province. It consists mainly of nearly level to moderately sloping tablelands, the southern part of which is dissected by the Little Blue River and its tributaries. Surface drainage flows into the Little Blue River, the West Fork of the Big Blue River, and the South Channel of the Platte River. More than four-fifths of the county drains to the Little Blue River. The Little Blue River and the South Channel of the Platte River are the only permanent flowing streams in most years. The other streams or creeks flow only after heavy rains, and some flow slightly from irrigation runoff during the irrigation season.

The Little Blue River and its tributaries dissect a large part of the county. The river valley averages about a mile in width and consists of nearly level remnant stream terraces 5 to 10 feet above the nearly level bottom lands, most of which are subject to occasional flooding. The bottom lands along the tributaries are subject to flooding during heavy rains, but the streams are dry most of the year. Major tributaries of the Little Blue River are Thirtytwo Mile, Cottonwood, Pawnee, Scott, and Sand Creeks, all of which drain to the south; and Flat, Dove, Ash, Crooked, and Oak Creeks, which drain to the north. The watersheds of these tributaries are gently rolling to steep. Between the watersheds are mostly nearly level to gently rolling loess plains.

The extreme northwestern corner of the county is drained by the South Channel of the Platte River and one of its tributaries Dry Creek. The Platte River valley consists of nearly level to gently sloping, alluvial bottom lands and a continuous, narrow strip of alluvial stream terrace between the bottom lands and the uplands. Some areas of the stream terrace have been reworked by the wind and redeposited to form low hummocks.

Another major drainageway in the county is the West Fork of the Big Blue River northeast of Hastings. This drains the northeastern corner of the county and flows eastward into the Big Blue River. Flat Creek, a major tributary of the West Fork of the Big Blue River, drains into it from the north.

A large area in the western part of the county has a low hummocky or dunelike topography, and there are intervening valleys and swales and some steep areas along the larger drainageways. The drainage pattern in this area is not always well defined. In the sandhill areas, most of the moisture enters the soil and there is very little runoff.

The rest of Adams County is a nearly level to moderately sloping loess plain that is dissected by small drainageways. Some of the drainage in the county is into land-locked basins or depressions. The water is ponded in these areas until it evaporates or is absorbed slowly by the soil.

The average elevation of the county is about 1,950 feet above sea level. The elevation ranges from about 2,120 feet in the uplands northwest of Kenesaw to about 1,750 feet where the Little Blue River crosses the eastern boundary. Average elevation of the bottom lands of the Platte River is about 2,000 feet, and the elevation along the Little Blue River is about 1,825 feet. The elevation of Hastings is 1,934 feet; Kenesaw is 2,051 feet, and Roseland is 1,969 feet.

Water Supply

The primary source of water for irrigation and industrial, municipal, domestic, and livestock uses in Adams County is ground water (*3*). Most of the ground water is derived from saturated deposits of sand and gravel. In the uplands the depth to water ranges from 110 feet to as much as 150 feet. On the flood plains of the Platte and the Little Blue Rivers, the depth to water is commonly less than 15 feet.

Within a broad east-west band that extends across the central part of the county, wells can be developed that

yield more than 1,000 gallons per minute. Elsewhere in the county the maximum yields may be somewhat less, and in the extreme southeastern part, yields may be as small as 50 gallons per minute.

The greatest withdrawals of water are for irrigation of field crops. The amount of ground water pumped for irrigation varies greatly from season to season, depending on the rainfall received, but has increased considerably over the years. The greatest single withdrawal of ground water is for municipal and industrial uses in Hastings.

The ground water is suitable for most purposes, except that it is hard. The hardness is caused by calcium and magnesium salts that are not detrimental in irrigation water and can be removed for domestic and industrial uses.

The Little Blue River and the South Channel of the Platte River, the only permanent flowing streams in most years, provide water for irrigation, livestock, and recreation. Many small dams and storage pits located throughout the county store water for livestock and irrigation. The lakes formed by some of the larger dams are used for recreation.

Transportation and Markets

Good transportation routes passing through Hastings are provided by U.S. Highways 281, 6, and 34. State Highway 74 runs east to west across the southern part of the county and connects Ayr, Roseland, and Holstein. The State maintains hard-surfaced roads to all of the towns and villages. Rural roads run on most of the section lines, except in the sandhill areas of the county. The majority of the roads are gravelled. Rural mail routes reach all parts of the county.

The Union Pacific, the Burlington Northern, and the Missouri Pacific railroads provide the county with ample rail service. Hastings and the surrounding communities are also served by major trucking companies and bus lines. A major commercial airline operates regular flights from the Hastings municipal airport.

Livestock auctions are held each week in Grand Island, Blue Hill, Minden, and Kearney, all in adjoining counties. Livestock not sold at a nearby auction is generally shipped or trucked to larger markets at Omaha and Kansas City.

Most of the poultry and dairy products are marketed locally. Grain and feed products not used or stored on the farm are marketed at local elevators, from which they are transported by rail or truck to larger markets.

Climate [8]

Adams County has a continental climate. There are no bodies of water nearby that are large enough to have a noticeable influence on the climate. The warm summers are punctuated by thundershowers followed by brief spells of cooler weather. The winters are normally cold and dry. There are great variations in temperature and rainfall from day to day and from season to season. Most of the moisture that falls in the county is brought in from the Gulf of Mexico and the Caribbean Sea. As a rule, more than three-fourths of the annual precipitation falls during the months of April to September, when the prevailing winds are southerly.

Slow, steady rains or rain mixed with snow characterize the precipitation early in spring. Snow is common in the first part of March, but by the latter half of the month much of the precipitation falls as rain. Snow that falls in April seldom remains on the ground for more than a day. As spring advances more and more of the moisture falls as brief showers, and by mid-May most of the precipitation is associated with thundershowers. Thunderstorms in spring and early in summer become severe at times and may be accompanied by local downpours, hail, and damaging winds or an occasional tornado. The severe storms are generally local and of short duration. The hail produces damage in an extremely variable and spotted pattern, but in the center of the more intense storms there may be a total loss of crops. Although the loss may be severe or total to individual farms, the associated rains cover a much larger area and there is often an economic gain to the area as a whole.

Table 10 shows that June normally receives more precipitation than any other month. Actually, the peak is reached during the second week of June, after which time the showers gradually become lighter and further apart. With the coming of fall the amount of precipitation received shows a definite downward trend, there are fewer thunderstorms, and the weather is characterized by an abundance of sunshine, mild days, and cool nights.

The frequency of very dry or very wet months is also shown in table 10. For example, it shows that on the average, one July in 10 will have less than 1 inch of moisture and one July in 10 will receive over 5.9 inches.

Precipitation in winter is generally light, and practically all of it falls as snow, although many winters have one or more periods of freezing rain. The snow is often accompanied by strong northerly winds and a change to colder weather. Average annual snowfall is about 28 inches, but there is considerable variation from year to year. Frequently the snow melts before the next snowfall arrives, and during an average winter there are only 46 days when the ground is covered by snow.

The frequency of high and low temperatures is indicated in table 10. For example, the table shows that in 1 year out of 5 there are at least 4 days in July when the temperature rises to 101° or higher. Likewise, it shows that in 1 year out of 5 the temperature in January falls to 7° below zero or lower on four nights. Temperatures have been recorded as high as 116° in 1936 and as low as –30° in 1899 and 1912. The average annual high is 103°, and the average annual low is 13° below zero.

The probabilities of freezing temperatures occuring after specified dates in spring or before certain dates in fall are shown in table 11. For example, in half of the years the air temperature can be expected to fall below 32° after April 30 (average date of the last freeze) and in 1 year in 10 there will be a freeze as late as May 16. In fall a freeze can be expected before September 27 in 1 year in 10.

Annual free-water evaporation from shallow lakes or ponds averages about 48 inches, and approximately 75 percent of the total occurs during the 6-month period, May through October.

[8] By RICHARD E. MYERS, climatologist for Nebraska, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation*

[Data from Hastings]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with [2]— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with [2]— Minimum temperature equal to or lower than—	Average monthly total [1]	One year in 10 will have [3]— Equal to or less than—	One year in 10 will have [3]— Equal to or more than—	Days with 1 inch or more of snow cover [1]	Average depth of snow on days with snow cover [1]
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Number	Inches
January	35	13	55	−7	0.7	0.1	1.2	15	5
February	40	18	64	−1	1.0	.1	1.8	10	5
March	49	25	72	7	1.6	.3	2.5	8	5
April	64	39	84	24	2.4	.6	4.6	1	2
May	74	49	89	37	4.0	1.5	6.8	(4)	3
June	83	59	99	48	4.8	1.3	7.5	0	----------
July	90	64	101	55	3.3	1.0	5.9	0	----------
August	88	62	99	52	3.4	1.3	6.2	0	----------
September	79	52	97	39	2.6	.7	5.3	0	----------
October	69	42	85	27	1.3	.2	3.8	(4)	3
November	51	28	70	8	.7	(5)	2.4	3	3
December	40	18	59	−2	.8	(5)	1.6	8	3
Year	63	39	[6] 103	[7] −13	26.6	16.7	34.1	46	5

[1] Data based on records from 1940–69.
[2] Data based on records from 1948–63.
[3] Data based on records from 1884–1969.
[4] Less than one-half day.
[5] Trace.
[6] Average annual highest temperature.
[7] Average annual lowest temperature.

TABLE 11.—*Probabilities of temperatures in spring and in fall* [1]

[All data from Clay Center, Clay County, Nebraska]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 7	April 15	April 20	May 5	May 16.
2 years in 10 later than	April 2	April 10	April 15	April 29	May 11.
5 years in 10 later than	March 23	March 30	April 4	April 18	April 30.
Fall:					
1 year in 10 earlier than	October 23	October 21	October 17	October 6	September 27.
2 years in 10 earlier than	November 3	October 26	October 22	October 12	October 2.
5 years in 10 earlier than	November 14	November 5	November 1	October 22	October 12.

[1] All freeze data are based on temperatures in a standard National Weather Service thermometer shelter at a height of approximately 5 feet above the ground and in a representative exposure. Temperatures will be lower at times nearer the ground and in local areas subject to extreme air drainage.

Farming

Farming in Adams County is based mainly on the growing of wheat, corn, and grain sorghum as cash crops, but production of livestock is also important.

In 1964, according to the U.S. Census of Agriculture, there were 1,025 farms in the county, down from 1,136 in 1959. The average size of farm in 1964 was 351.5 acres. In 1964, 281,316 acres were in cropland, 65,110 acres were rangeland, and 969 acres were woodland or in windbreaks.

The acreage of the principal crops harvested in the county in 1964, was as follows: corn for all purposes, 36,199 acres; sorghum for all purposes, 61,003 acres; wheat, 78,117 acres; and alfalfa, 10,202 acres.

Of the total acreage in corn and sorghum, 27,635 acres of corn and 8,381 acres of sorghum were irrigated. Most of the corn and grain sorghum is harvested for grain or seed. Soybeans were harvested from 1,242 acres. Wild hay was cut from 1,927 acres. The total acreage in cultivated summer fallow was 68,673 acres. Since 1964, the total acreage in corn has nearly doubled. The acreage of irrigated corn has greatly increased, and the acreage of dryfarmed corn has decreased. The acreage in dryfarmed sorghum has decreased slightly. Although only a small

acreage of soybeans is grown in the county, the acreage is steadily increasing. Acreage of other crops has remained at about the same level.

Livestock in Adams County consists mainly of cattle and hogs. Livestock in the county in 1964 consisted of 38,516 cattle and calves, 15,981 hogs and pigs, 3,931 sheep and lambs, and 57,805 chickens.

There has been a slight increase in the number of cattle and hogs since 1964. The number of sheep and chickens has decreased during the same period.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this soil survey, available water capacity is given to a depth of 60 inches or to a limiting layer, whichever is less. The classes are (1) *high*, more than 9 inches; (2) *moderate*, 6 to 9 inches; (3) *low*, 3 to 6 inches; and (4) *very low*, 0 to 3 inches.

Bottom land. The normal flood plain of a stream, part of which may be flooded frequently.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Narrow steps on steep hillsides produced by slumping or soil slippage.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, soil. The total thickness of weathered soil material over bedrock or mixed sand and gravel. In this soil survey, the classes of soil depth are (1) *deep*, more than 40 inches; (2) *moderately deep*, 20 to 40 inches; (3) *shallow*, 10 to 20 inches; and (4) *very shallow*, 0 to 10 inches.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesqui-

oxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Organic matter, soil. The organic fraction of the soil. It includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. It is commonly determined as those organic materials that accompany the soil material when it is put through a 2-millimeter sieve. In this soil survey, the ratings for organic-matter content are (1) *moderate,* 2.0 to 4.0 percent; (2) *moderately low,* 1.0 to 2.0 percent; (3) *low,* 0.5 to 1.0 percent; and (4) *very low,* less than 0.5 percent.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability, soil. The quality that enables the soil to transmit water or air. In this soil survey, permeability applies to that part of the soil below the Ap horizon or an equivalent depth and above a depth of 60 inches or above bedrock. If there is a difference in permeability of two or more classes within a short vertical distance in the profile, both the classes and the depth are given. The classes of permeability, in inches of water per hour, are (1) *very slow,* less than 0.06 inch; (2) *slow,* 0.06 to 0.2 inch; (3) *moderately slow,* 0.2 to 0.6 inch; (4) *moderate,* 0.6 inch to 2.0 inches; (5) *moderately rapid,* 2.0 to 6.0 inches; (6) *rapid,* 6.0 to 20 inches; and (6) *very rapid,* more than 20 inches.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope, soil. The degree of deviation of the soil surface from the horizontal, generally expressed in percent or degrees. In this soil survey, the slope classes are (1) *nearly level,* 0 to 1 percent; (2) *gently sloping,* 1 to 3 percent; (3) *moderately sloping,* 3 to 7 percent; (4) *strongly sloping,* 7 to 11 percent; (5) *steep,* 11 to 31 percent; and (6) *very steep,* more than 31 percent.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Underlying material. Weathered soil material immediately beneath the solum. See Substratum.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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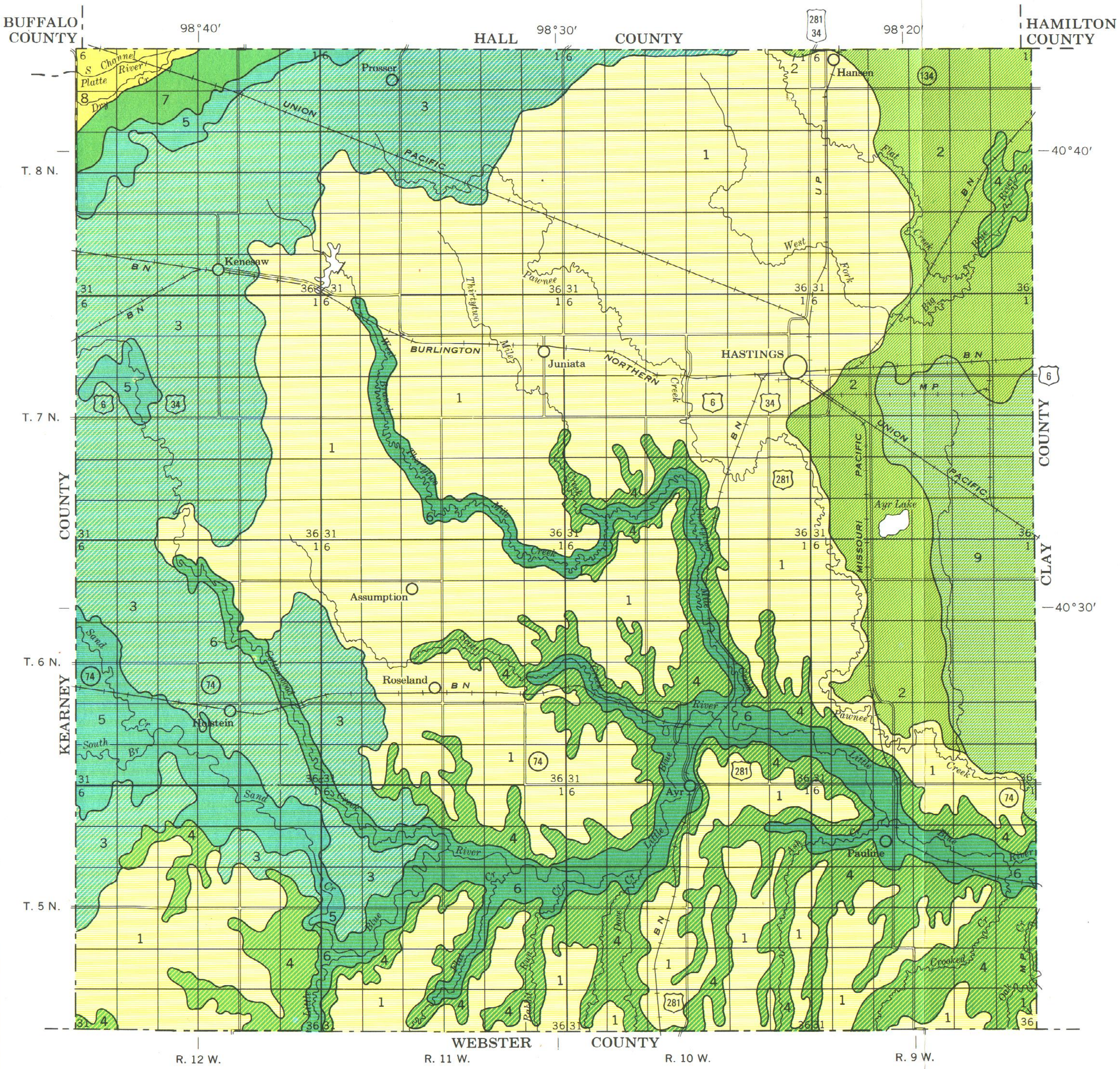
GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management. For information about windbreak suitability groups, see the section beginning on page 48. For facts about wildlife and recreation, turn to the section beginning on page 49. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Predicted yields, table 2, page 42.

Engineering uses of the soils, tables 6, 7, and 8, pages 52 through 67.

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page	Windbreak suitability group Name
2An	Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	10	IIe-3	35	IIe-3	35	Sandy	45	Sandy
2AnA	Anselmo fine sandy loam, terrace, 1 to 3 percent slopes	10	IIIe-31	37	IIe-31	37	Sandy	45	Sandy
2Ap	Anselmo loam, terrace, 0 to 1 percent slopes	10	IIc-1	34	I-1	34	Sandy	45	Silty to Clayey
Bu	Butler silt loam	11	IIw-2	35	IIs-21	35	Clayey	45	Silty to Clayey
By	Breaks-Alluvial land complex	10	VIe-1	39	------	--	----------------	--	---------------
	Breaks part	--	------	--	------	--	Silty	45	Undesirable
	Alluvial land part	--	------	--	------	--	Silty Overflow	43	Undesirable
CbC	Coly silt loam, 7 to 11 percent slopes	13	IVe-8	39	------	--	Limy Upland	46	Silty to Clayey
CbD	Coly silt loam, 11 to 31 percent slopes	13	VIe-9	40	------	--	Limy Upland	46	Silty to Clayey
Ce	Crete silt loam	14	IIs-2	35	IIs-2	35	Clayey	45	Silty to Clayey
Cm	Cass loam	12	I-1	34	I-2	34	Sandy Lowland	43	Silty to Clayey
2Cm	Cass loam, occasionally flooded	12	IIw-3	36	IIw-3	36	Sandy Lowland	43	Moderately Wet
Cs	Cass fine sandy loam	12	IIe-3	35	IIe-3	35	Sandy Lowland	43	Sandy
Fm	Fillmore silt loam	14	IIIw-2	38	IIs-22	38	Clayey Overflow	45	Moderately Wet
GeB2	Geary silty clay loam, 3 to 7 percent slopes, eroded	16	IIIe-8	38	IIIe-11	38	Silty	45	Silty to Clayey
GeC2	Geary silty clay loam, 7 to 11 percent slopes, eroded	16	IVe-8	39	------	--	Silty	45	Silty to Clayey
GsB	Geary silt loam, 3 to 7 percent slopes	15	IIIe-1	37	IIIe-1	37	Silty	45	Silty to Clayey
GsC	Geary silt loam, 7 to 11 percent slopes	15	IVe-1	39	------	--	Silty	45	Silty to Clayey
GsE	Geary silt loam, 11 to 31 percent slopes	15	VIe-1	39	------	--	Silty	45	Silty to Clayey
Ha	Hall silt loam	17	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
2Hb	Hobbs silt loam, occasionally flooded	20	IIw-3	36	IIw-3	36	Silty Overflow	43	Moderately Wet
Hd	Hord silt loam, 0 to 1 percent slopes	23	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
2Hd	Hord silt loam, terrace, 0 to 1 percent slopes	23	IIc-1	34	I-1	34	Silty Lowland	43	Silty to Clayey
2HdA	Hord silt loam, terrace, 1 to 3 percent slopes	23	IIe-1	34	IIe-1	34	Silty	45	Silty to Clayey
Hg	Holder silt loam, 0 to 1 percent slopes	21	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
HgA	Holder silt loam, 1 to 3 percent slopes	21	IIe-1	34	IIe-1	34	Silty	45	Silty to Clayey
HgB	Holder silt loam, 3 to 7 percent slopes	21	IIIe-1	37	IIIe-1	37	Silty	45	Silty to Clayey
HgB2	Holder silt loam, 3 to 7 percent slopes, eroded	21	IIIe-1	37	IIIe-1	37	Silty	45	Silty to Clayey
HgB3	Holder silty clay loam, 3 to 7 percent slopes, severely eroded	22	IIIe-8	38	IIIe-11	38	Silty	45	Silty to Clayey
HgC	Holder silt loam, 7 to 11 percent slopes	21	IVe-1	39	------	--	Silty	45	Silty to Clayey
HgC3	Holder silty clay loam, 7 to 11 percent slopes, severely eroded	22	IVe-8	39	------	--	Silty	45	Silty to Clayey
HmB	Hersh fine sandy loam, 3 to 7 percent slopes	19	IIIe-3	37	IIIe-3	37	Sandy	45	Sandy
HR	Hersh-Kenesaw complex, undulating	19	IIe-3	35	IIe-3	35	----------------	--	---------------
	Hersh part	--	------	--	------	--	Sandy	45	Sandy
	Kenesaw part	--	------	--	------	--	Silty	45	Silty to Clayey
Hs	Hastings silt loam, 0 to 1 percent slopes	17	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
HsA	Hastings silt loam, 1 to 3 percent slopes	17	IIe-1	34	IIe-1	34	Silty	45	Silty to Clayey
2Hs	Hastings silt loam, thin solum variant	18	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
Hv	Hobbs silt loam	19	I-1	34	I-2	34	Silty Lowland	43	Silty to Clayey
Ig	Inavale loamy fine sand	24	IIIe-5	38	IIIe-5	38	Sandy Lowland	43	Sandy
In	Inavale fine sandy loam	24	IIIe-3	37	IIIe-3	37	Sandy Lowland	43	Sandy
Ks	Kenesaw silt loam, 0 to 1 percent slopes	25	IIc-1	34	I-1	34	Silty	45	Silty to Clayey
KsA	Kenesaw silt loam, 1 to 3 percent slopes	25	IIe-1	34	IIe-1	34	Silty	45	Silty to Clayey
KsB	Kenesaw silt loam, 3 to 7 percent slopes	25	IIIe-1	37	IIIe-1	37	Silty	45	Silty to Clayey
2Ks	Kenesaw silt loam, terrace, 0 to 1 percent slopes	26	IIc-1	34	I-1	34	Silty Lowland	43	Silty to Clayey
LA	Lex and Alda soils	26	IIw-4	36	IIw-4	36	Subirrigated	43	Moderately Wet
M	Marsh	27	VIIIw-1	41	------	--	----------------	--	Undesirable
Ms	Meadin sandy loam	28	VIs-4	40	------	--	Shallow to Gravel	46	Shallow
Pt	Platte loam	28	VIw-4	40	IVw-4	40	Subirrigated	43	Moderately Wet
Rw	Riverwash	28	VIIIs-1	41	------	--	----------------	--	Undesirable
RB	Rough broken land, loess	29	VIIe-1	40	------	--	Thin Loess	46	Undesirable
Ru	Rusco silt loam	29	IIw-31	36	I-3	36	Silty Overflow	43	Moderately Wet
Sc	Scott silt loam	30	IVw-2	39	------	--	----------------	--	Undesirable
Sy	Silty alluvial land	30	VIw-1	40	------	--	Silty Overflow	43	Undesirable
S	Spoil banks	30	VIIe-1	40	------	--	Silty	45	Silty to Clayey
TxB	Thurman-Valentine loamy fine sands, undulating	31	IVe-5	39	------	--	Sandy	45	Sandy
VbC	Valentine loamy fine sandy, rolling	31	VIe-5	40	------	--	Sands	45	Very Sandy



SOIL ASSOCIATIONS*

1	Hastings-Holder association: Nearly level to moderately sloping, deep, silty soils on uplands
2	Hastings-Crete association: Nearly level to gently sloping, deep, silty soils on uplands
3	Kenesaw-Coly association: Nearly level to steep, deep, silty soils on uplands
4	Holder-Geary-Coly association: Moderately sloping to steep, deep, silty soils on uplands
5	Valentine-Thurman association: Undulating to rolling, deep, sandy soils on uplands and stream terraces
6	Hord-Cass-Hobbs association: Nearly level to gently sloping, deep, silty and loamy soils on stream terraces and bottom lands
7	Anselmo-Meadin association: Nearly level to gently sloping, deep and shallow, loamy soils; over sand and gravel; on stream terraces
8	Platte-Lex-Alda association: Nearly level to gently sloping, shallow and moderately deep, silty and loamy soils; over sand and gravel; on bottom lands
9	Crete-Hastings association: Nearly level, deep, silty soils on uplands

* Texture terms in the names of the associations refer to the surface layer of the major soils in each association.

Compiled 1973

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

ADAMS COUNTY, NEBRASKA

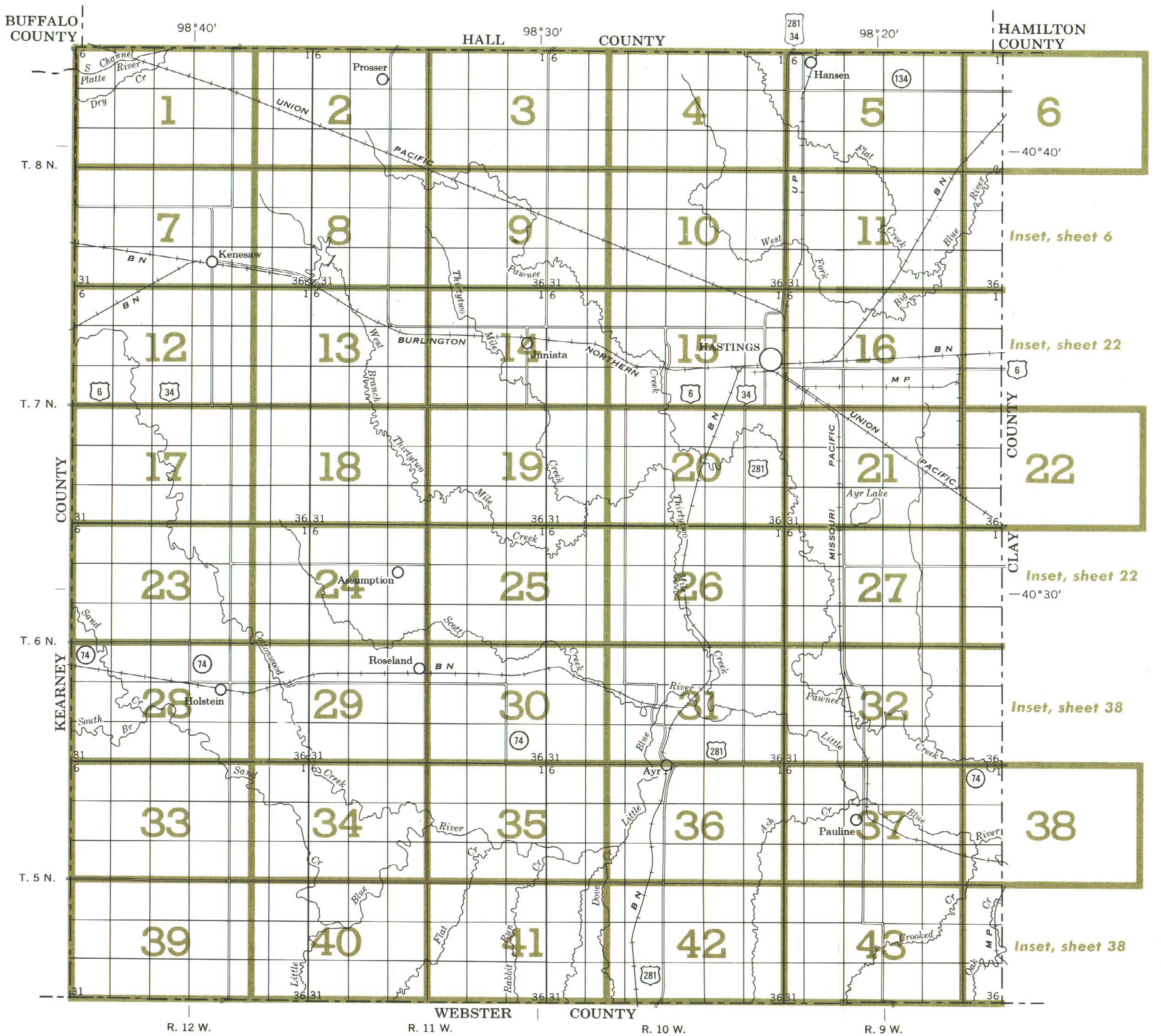
Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

ADAMS COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Each soil symbol consists of letters, or of letters and numbers; for example, HR, Hs, 2Hs or HgB2. If slope is given in the soil name and is more than 1 percent, the last capital letter, A, B, C, D, or E, in a symbol shows the slope class. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
2An	Anselmo fine sandy loam, terrace, 0 to 1 percent slopes
2AnA	Anselmo fine sandy loam, terrace, 1 to 3 percent slopes
2Ap	Anselmo loam, terrace, 0 to 1 percent slopes
Bu	Butler silt loam
By	Breaks-Alluvial land complex
CbC	Coly silt loam, 7 to 11 percent slopes
CbD	Coly silt loam, 11 to 31 percent slopes
Ce	Crete silt loam
Cm	Cass loam
2Cm	Cass loam, occasionally flooded
Cs	Cass fine sandy loam
Fm	Fillmore silt loam
GeB2	Geary silty clay loam, 3 to 7 percent slopes, eroded
GeC2	Geary silty clay loam, 7 to 11 percent slopes, eroded
GsB	Geary silt loam, 3 to 7 percent slopes
GsC	Geary silt loam, 7 to 11 percent slopes
GsE	Geary silt loam, 11 to 31 percent slopes
Ha	Hall silt loam
2Hb	Hobbs silt loam, occasionally flooded
Hd	Hord silt loam, 0 to 1 percent slopes
2Hd	Hord silt loam, terrace, 0 to 1 percent slopes
2HdA	Hord silt loam, terrace, 1 to 3 percent slopes
Hg	Holder silt loam, 0 to 1 percent slopes
HgA	Holder silt loam, 1 to 3 percent slopes
HgB	Holder silt loam, 3 to 7 percent slopes
HgB2	Holder silt loam, 3 to 7 percent slopes, eroded
HgB3	Holder silty clay loam, 3 to 7 percent slopes, severely eroded
HgC	Holder silt loam, 7 to 11 percent slopes
HgC3	Holder silty clay loam, 7 to 11 percent slopes, severely eroded
HmB	Hersh fine sandy loam, 3 to 7 percent slopes
HR	Hersh-Kenesaw complex, undulating
Hs	Hastings silt loam, 0 to 1 percent slopes
HsA	Hastings silt loam, 1 to 3 percent slopes
2Hs	Hastings silt loam, thin solum variant
Hv	Hobbs silt loam
Ig	Inavale loamy fine sand
In	Inavale fine sandy loam
Ks	Kenesaw silt loam, 0 to 1 percent slopes
KsA	Kenesaw silt loam, 1 to 3 percent slopes
KsB	Kenesaw silt loam, 3 to 7 percent slopes
2Ks	Kenesaw silt loam, terrace, 0 to 1 percent slopes
LA	Lex and Alda soils
M	Marsh
Ms	Meadin sandy loam
Pt	Platte loam
Rw	Riverwash
RB	Rough broken land, loess
Ru	Rusco silt loam
Sc	Scott silt loam
Sy	Silty alluvial land
S	Spoil banks
TxB	Thurman-Valentine loamy fine sands, undulating
VbC	Valentine loamy fine sand, rolling

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Well, irrigation

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

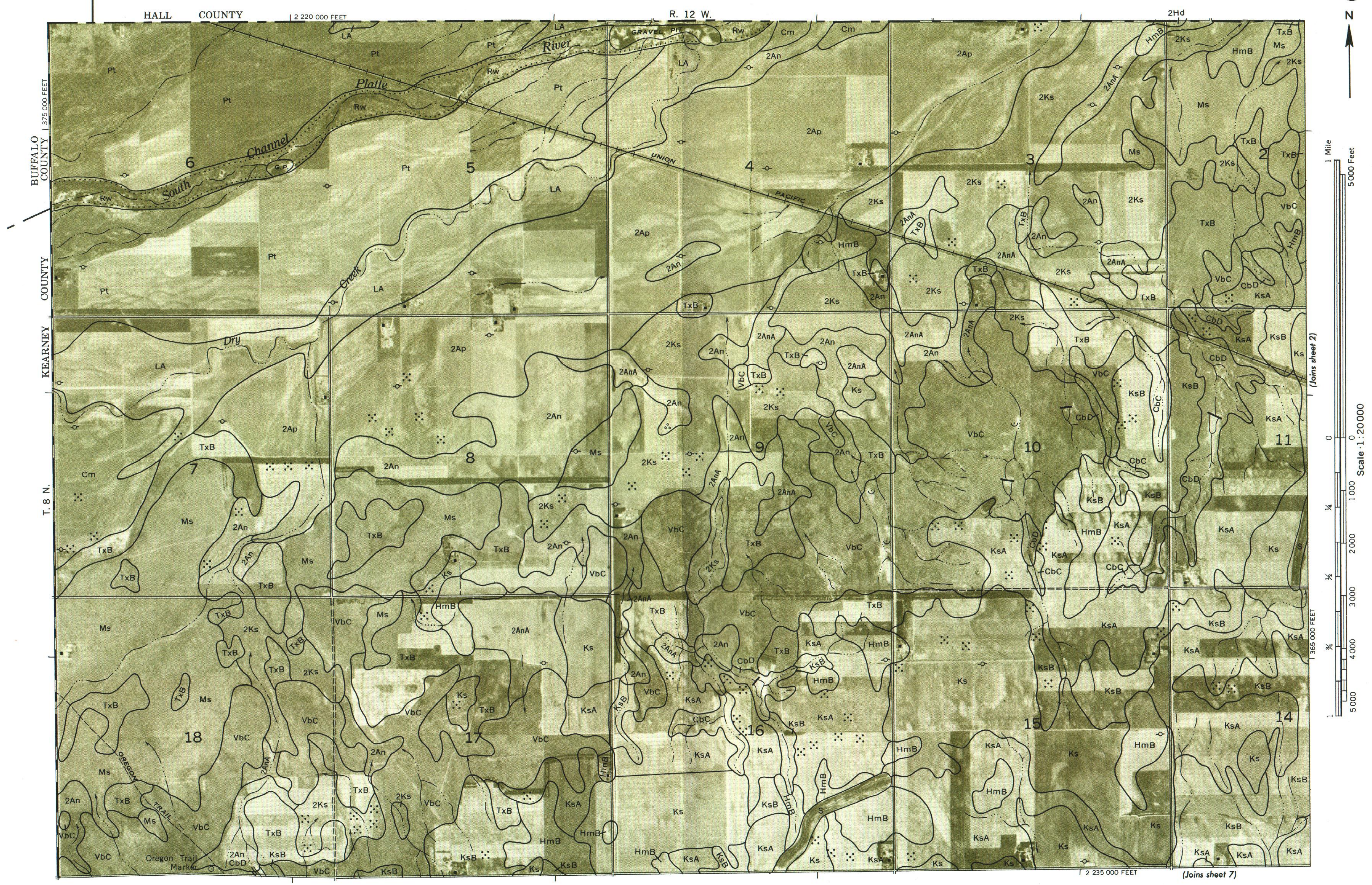
Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

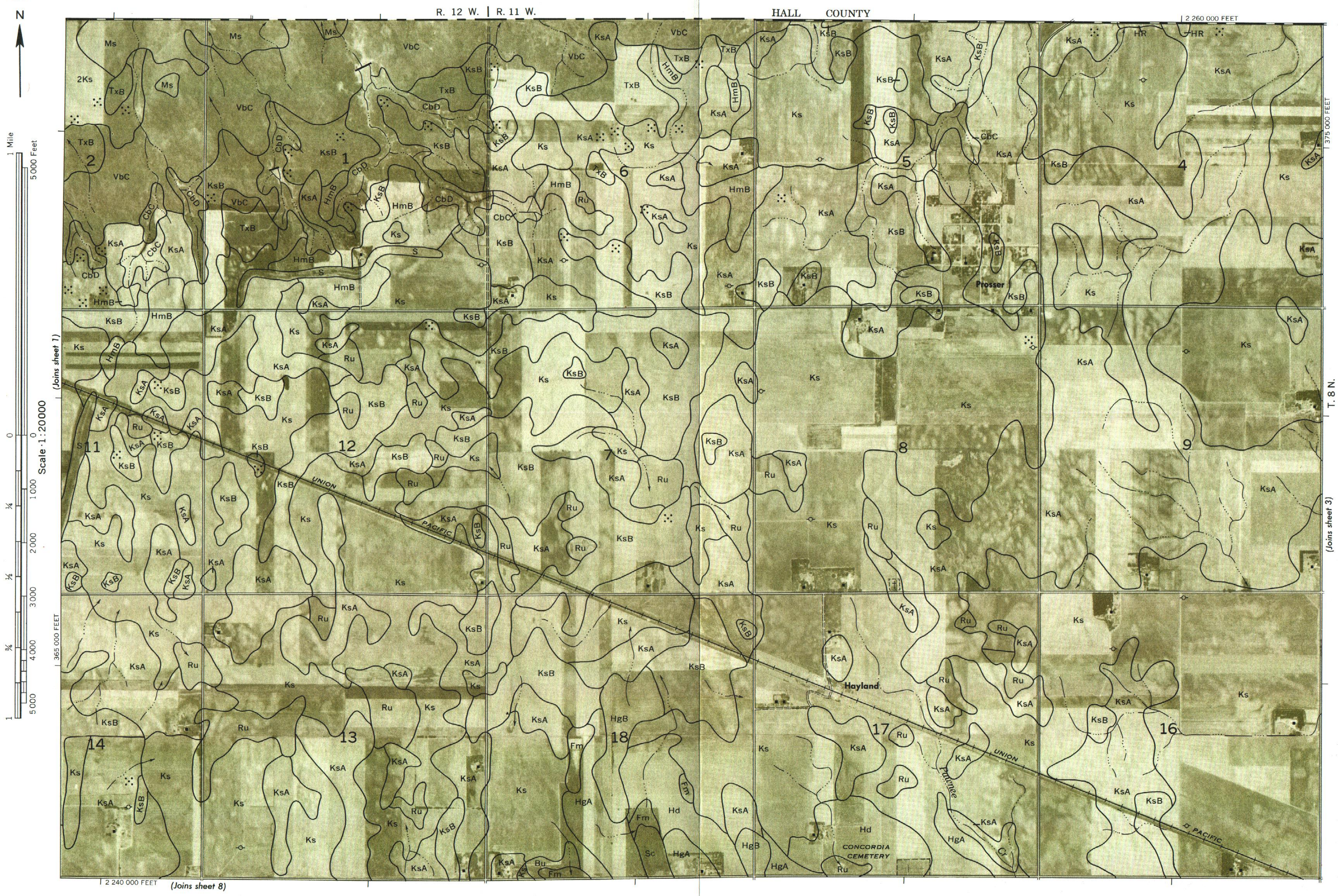
- Soil boundary and symbol — Dx
- Gravel
- Stoniness — Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully



ADAMS COUNTY, NEBRASKA NO. 1

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

2



Land division corners are approximately positioned on this map.

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ADAMS COUNTY, NEBRASKA NO. 2

ADAMS COUNTY, NEBRASKA NO. 3

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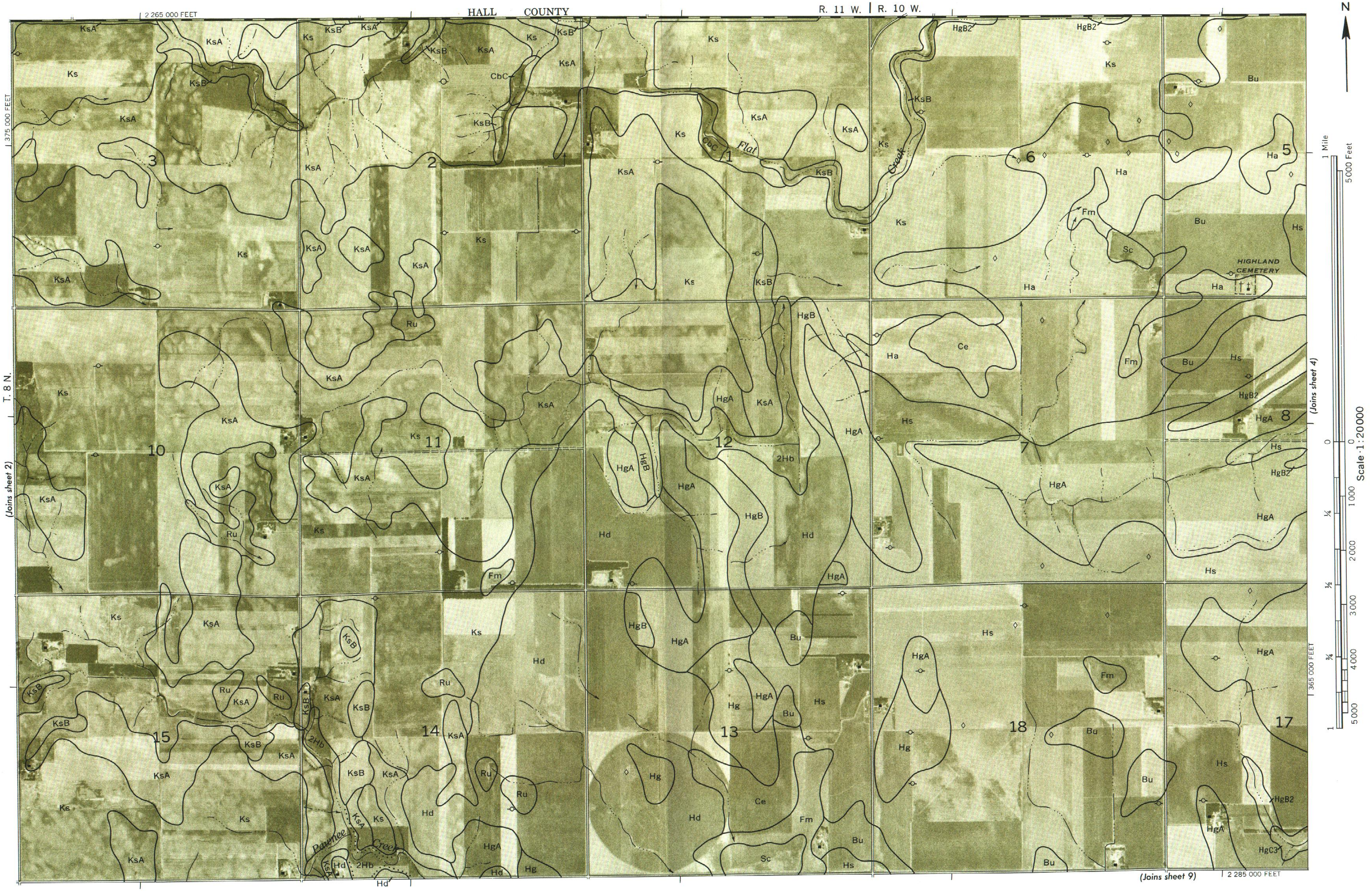
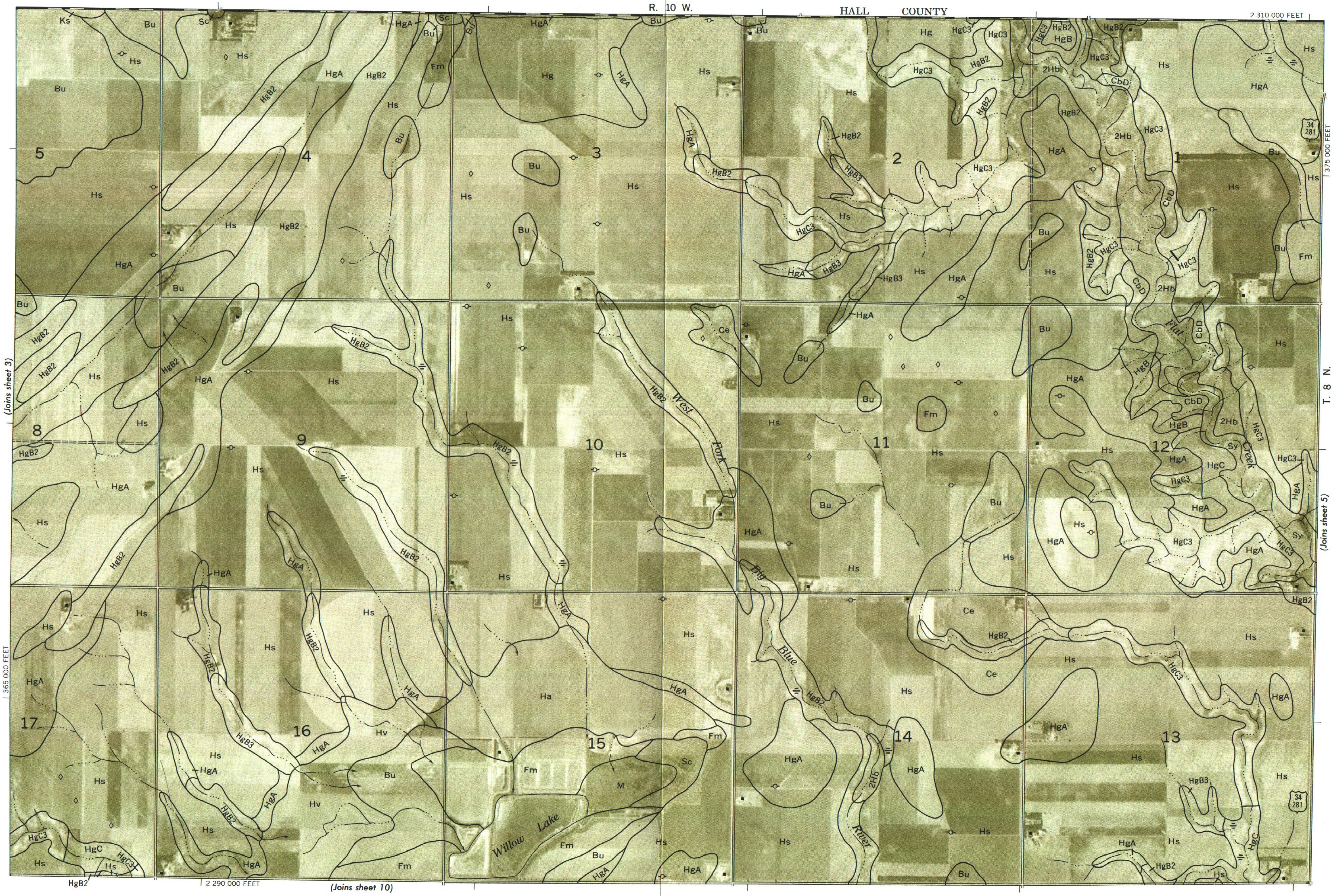


ADAMS COUNTY, NEBRASKA — SHEET NUMBER 4

N

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



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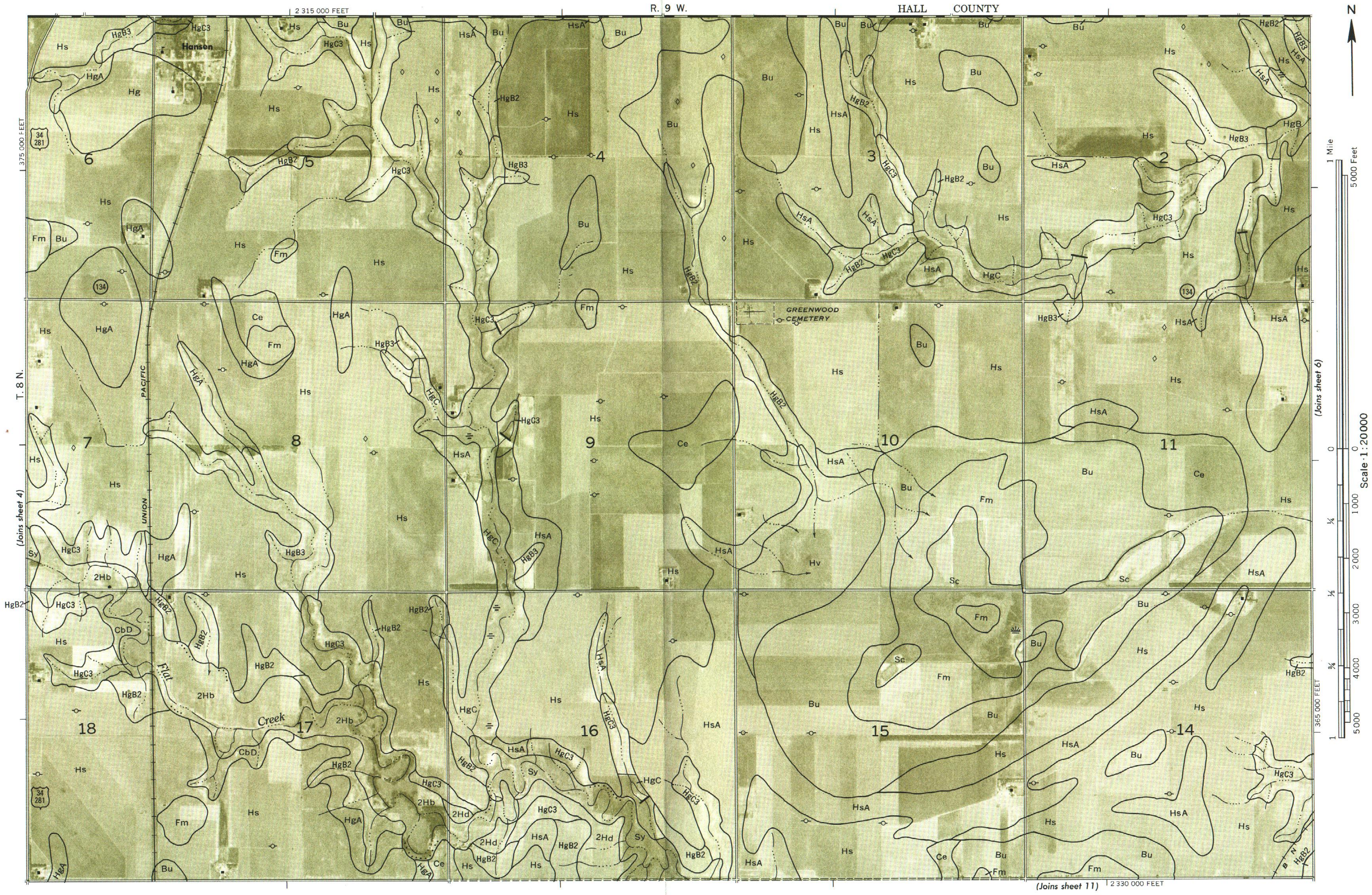
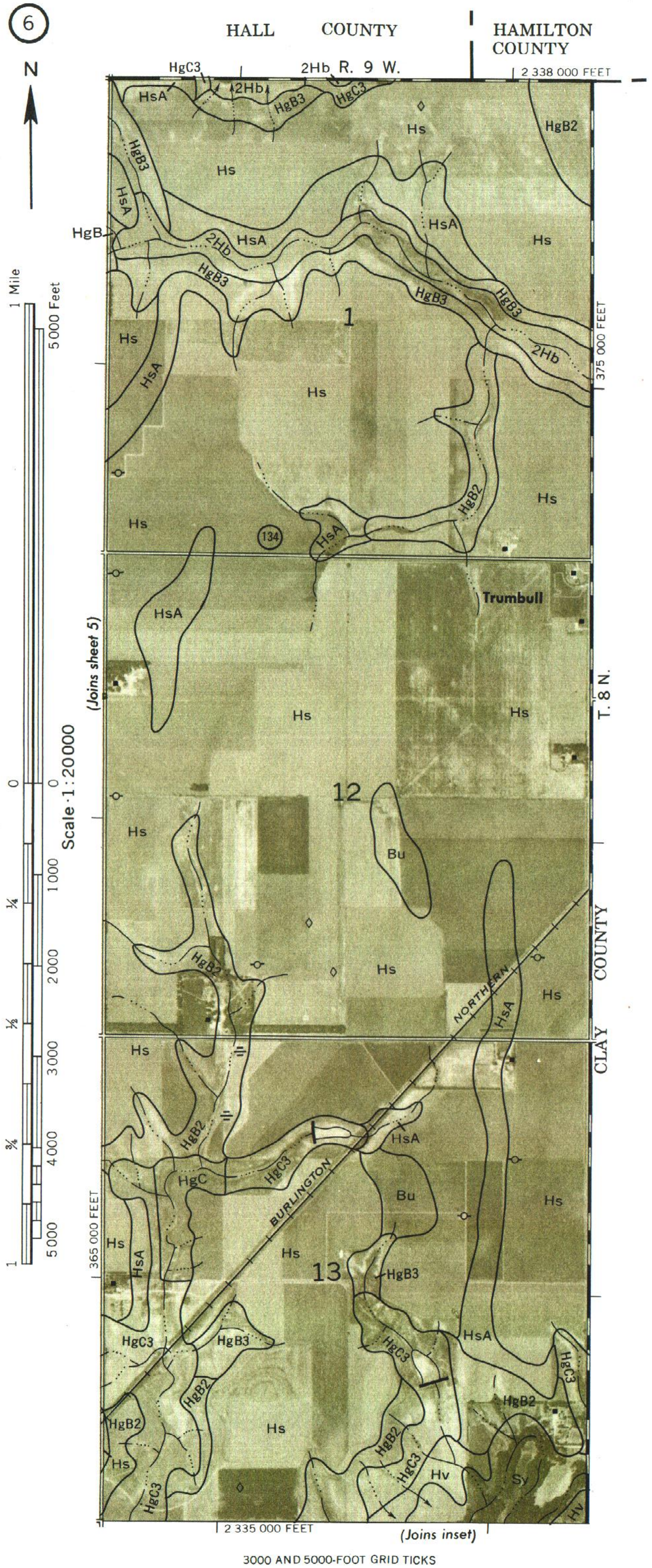
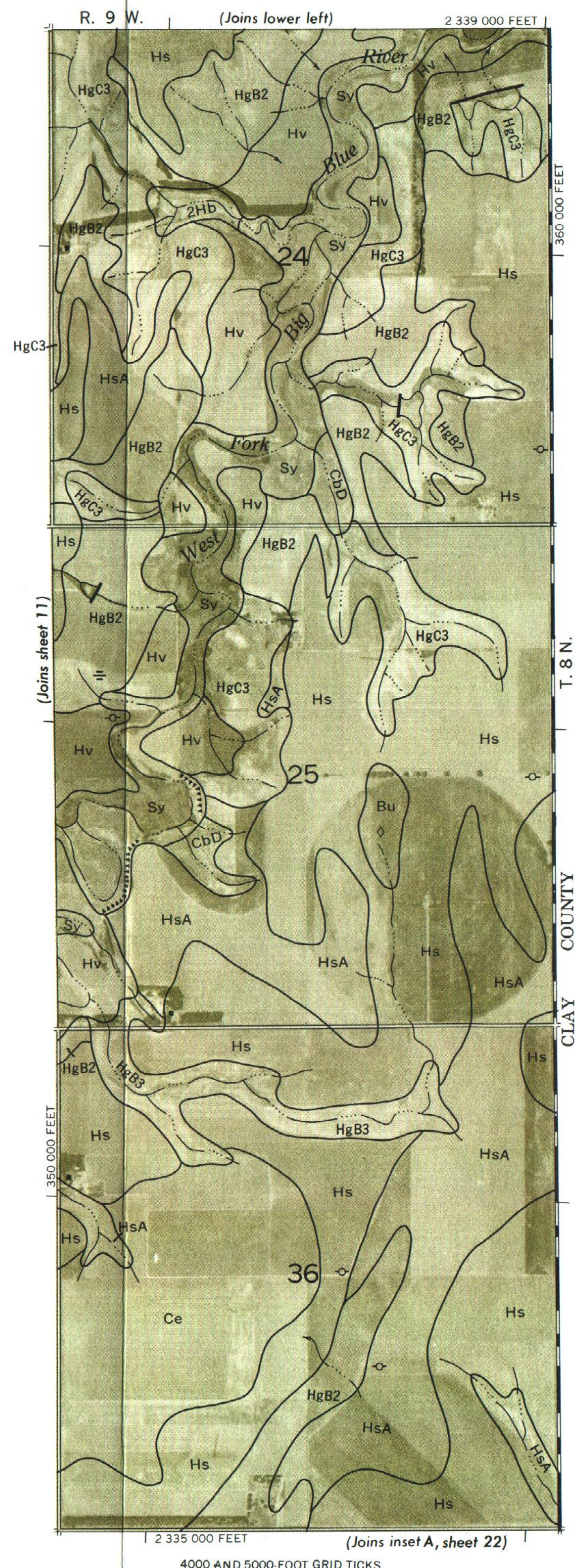
ADAMS COUNTY, NEBRASKA NO. 4



ADAMS COUNTY, NEBRASKA NO. 5

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.
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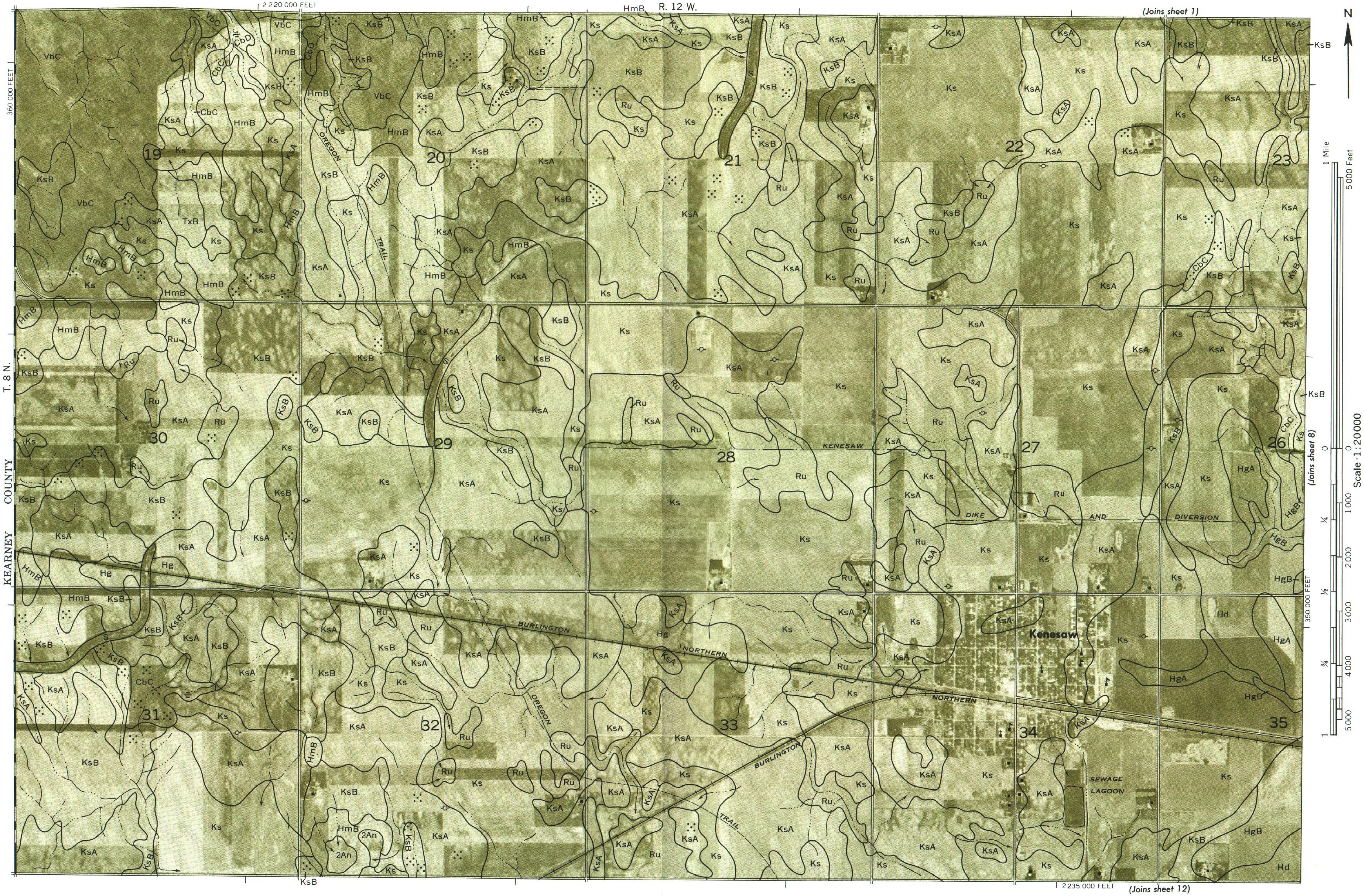

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
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Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 8

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

ADAMS COUNTY, NEBRASKA NO. 9

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ADAMS COUNTY, NEBRASKA — SHEET NUMBER 10

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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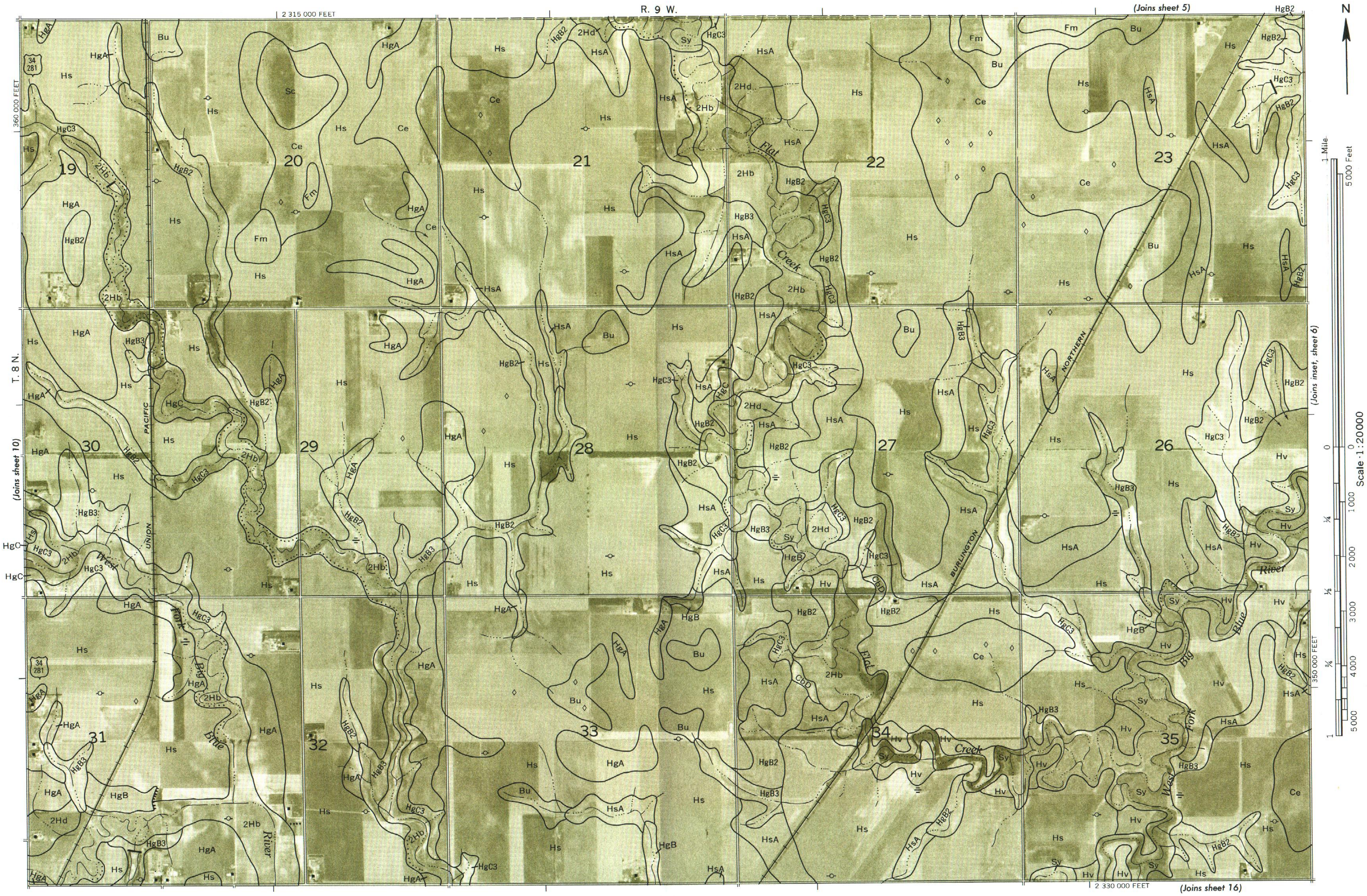

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ADAMS COUNTY, NEBRASKA NO. 11

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 12

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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ADAMS COUNTY, NEBRASKA — SHEET NUMBER 14

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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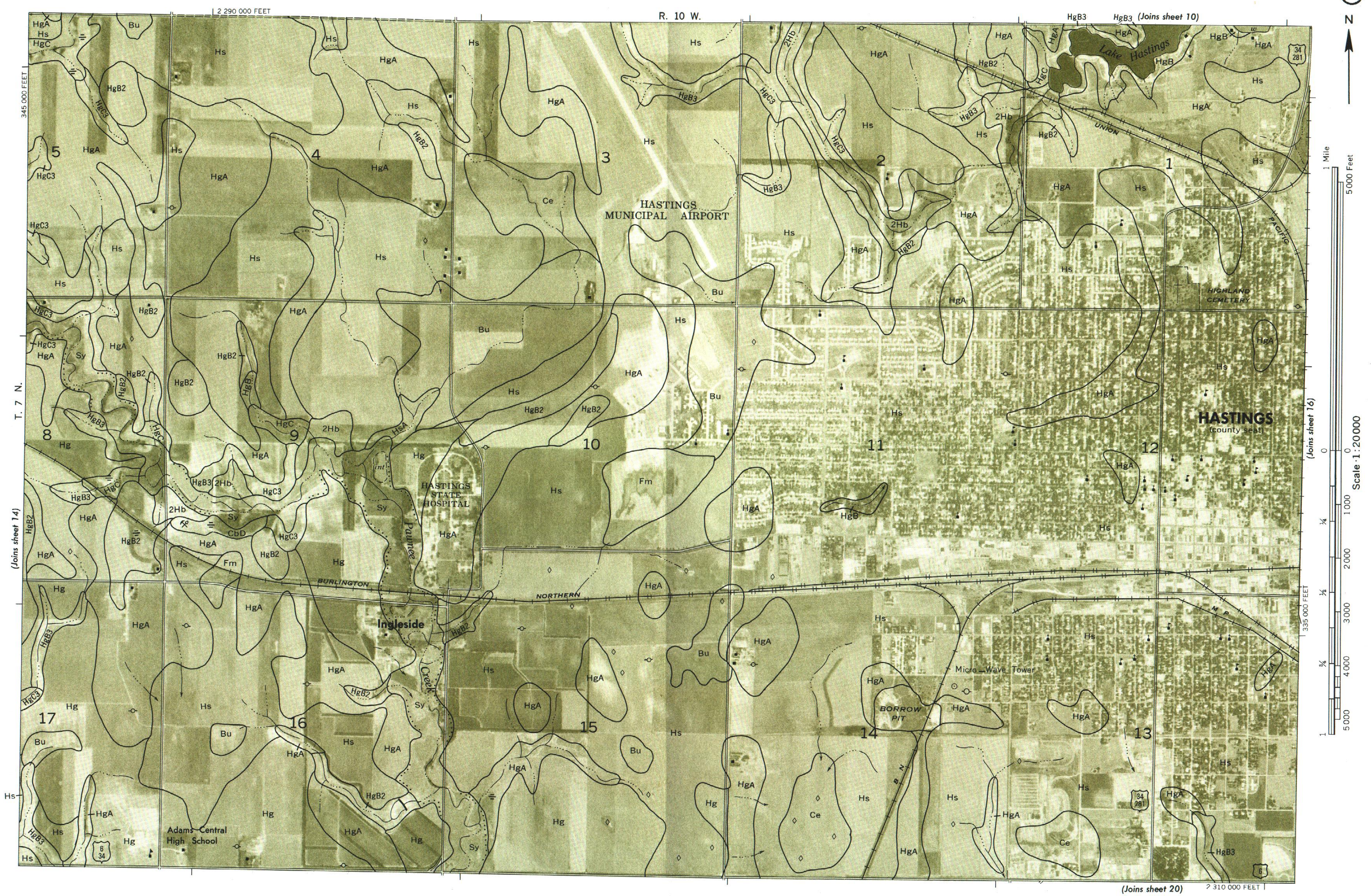

ADAMS COUNTY, NEBRASKA NO. 15

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
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ADAMS COUNTY, NEBRASKA NO. 17

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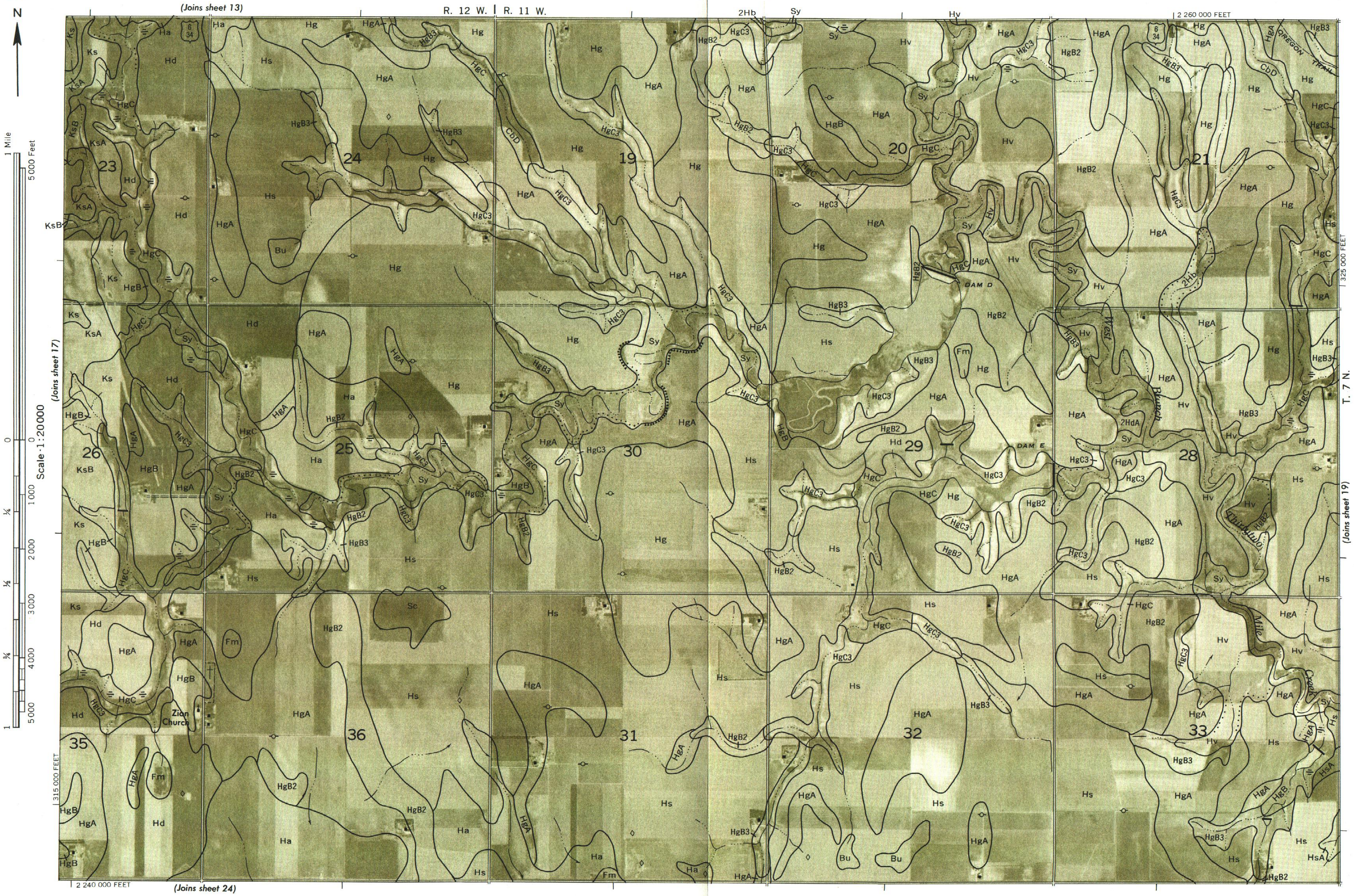
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 18



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
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ADAMS COUNTY, NEBRASKA NO. 19
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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 20

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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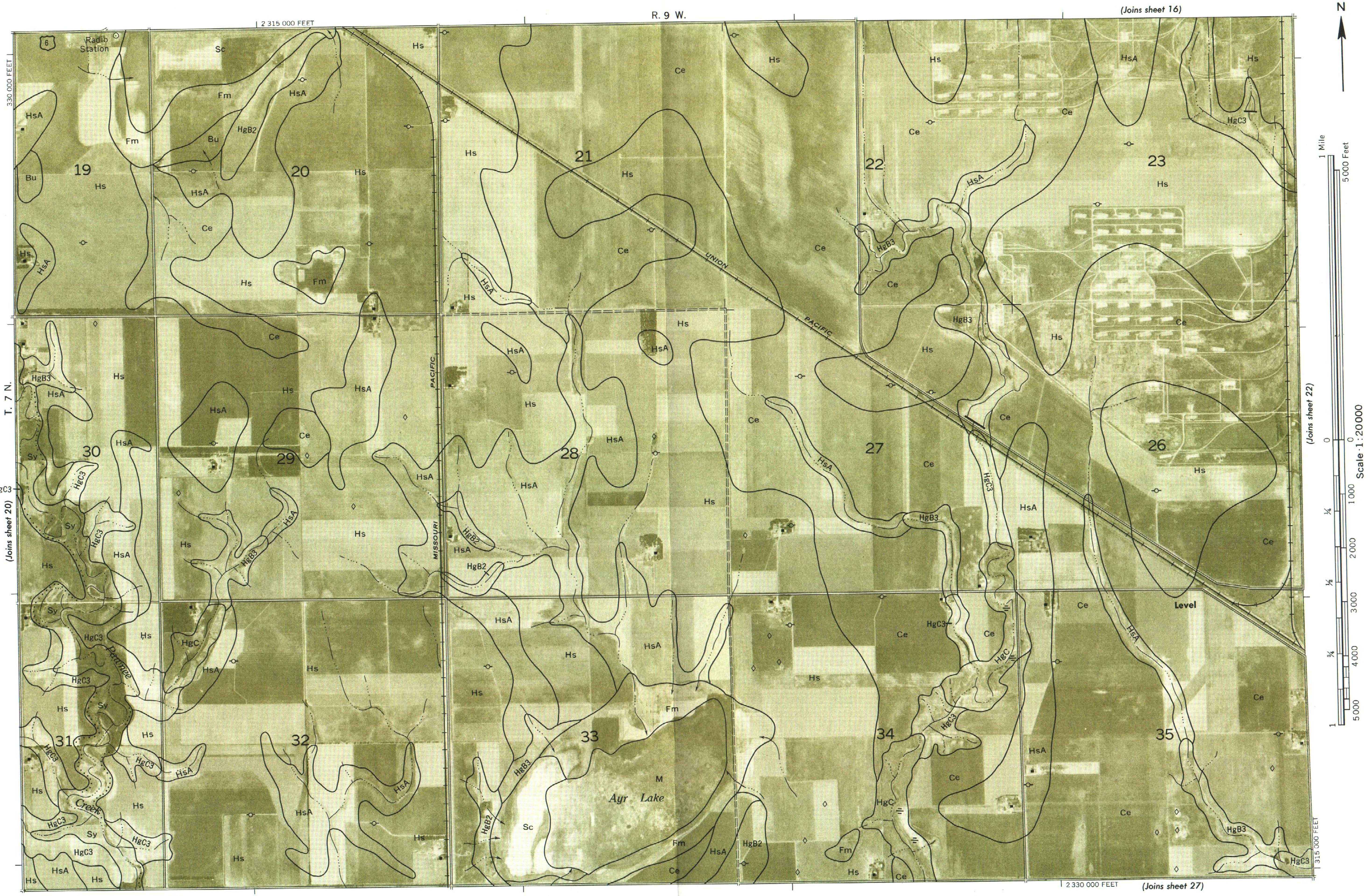

ADAMS COUNTY, NEBRASKA NO. 21

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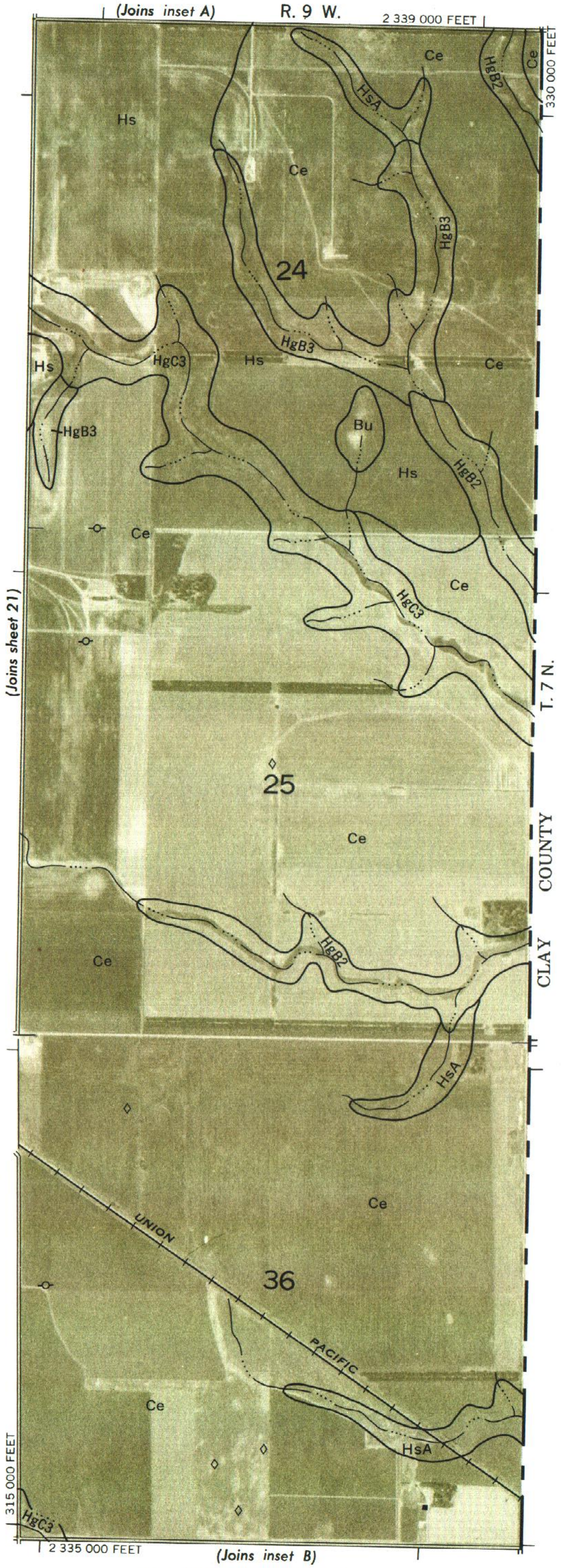
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

N

Scale 1:20000

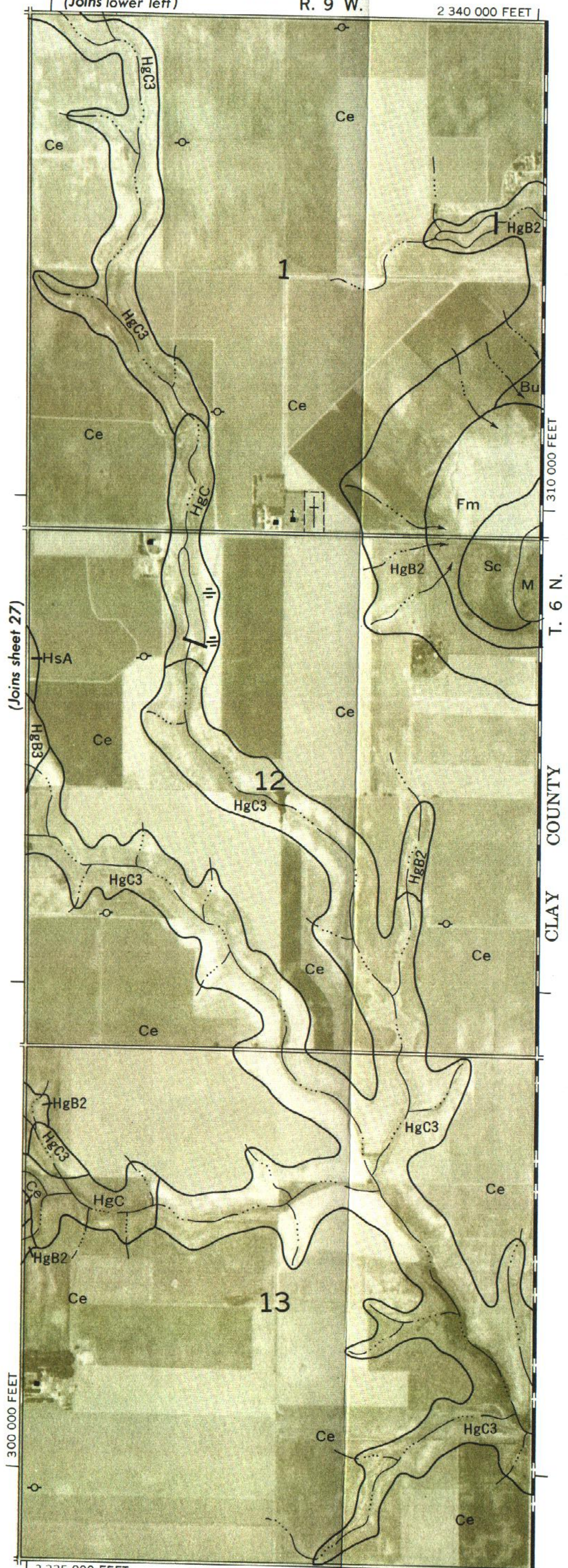
1 Mile ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

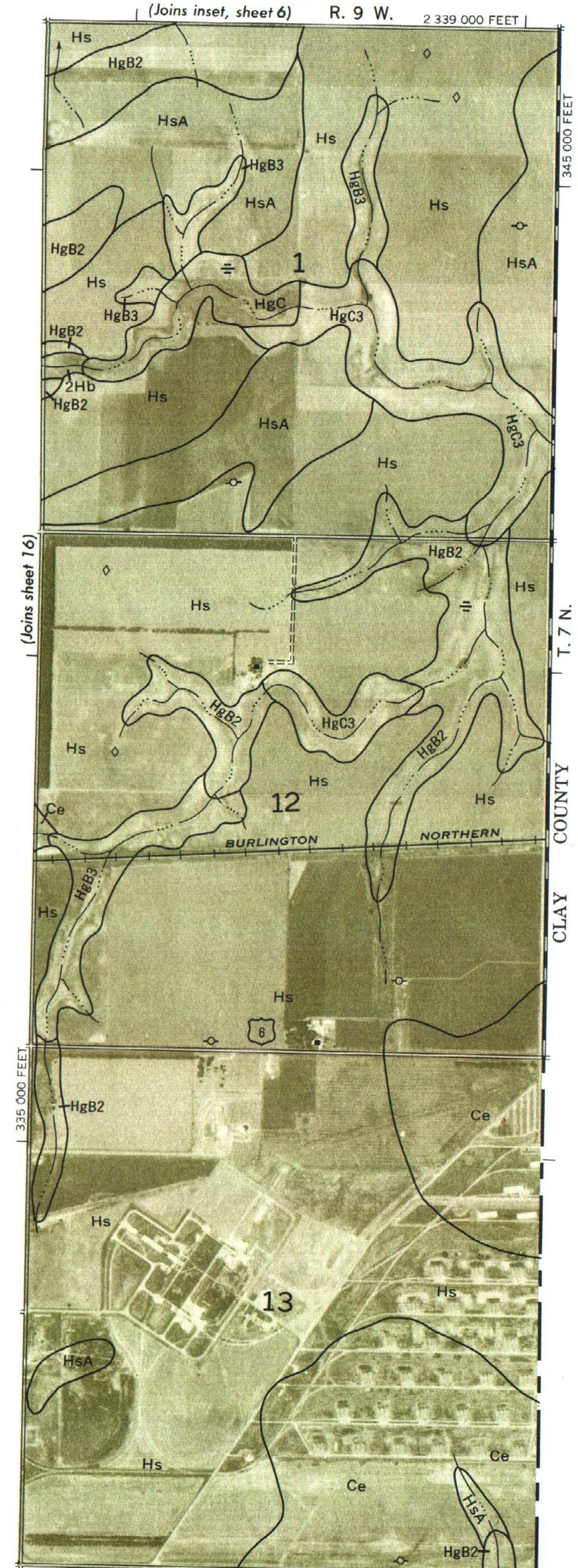


1000 AND 5000-FOOT GRID TICKS

INSET B



INSET A



4000 AND 5000-FOOT GRID TICKS

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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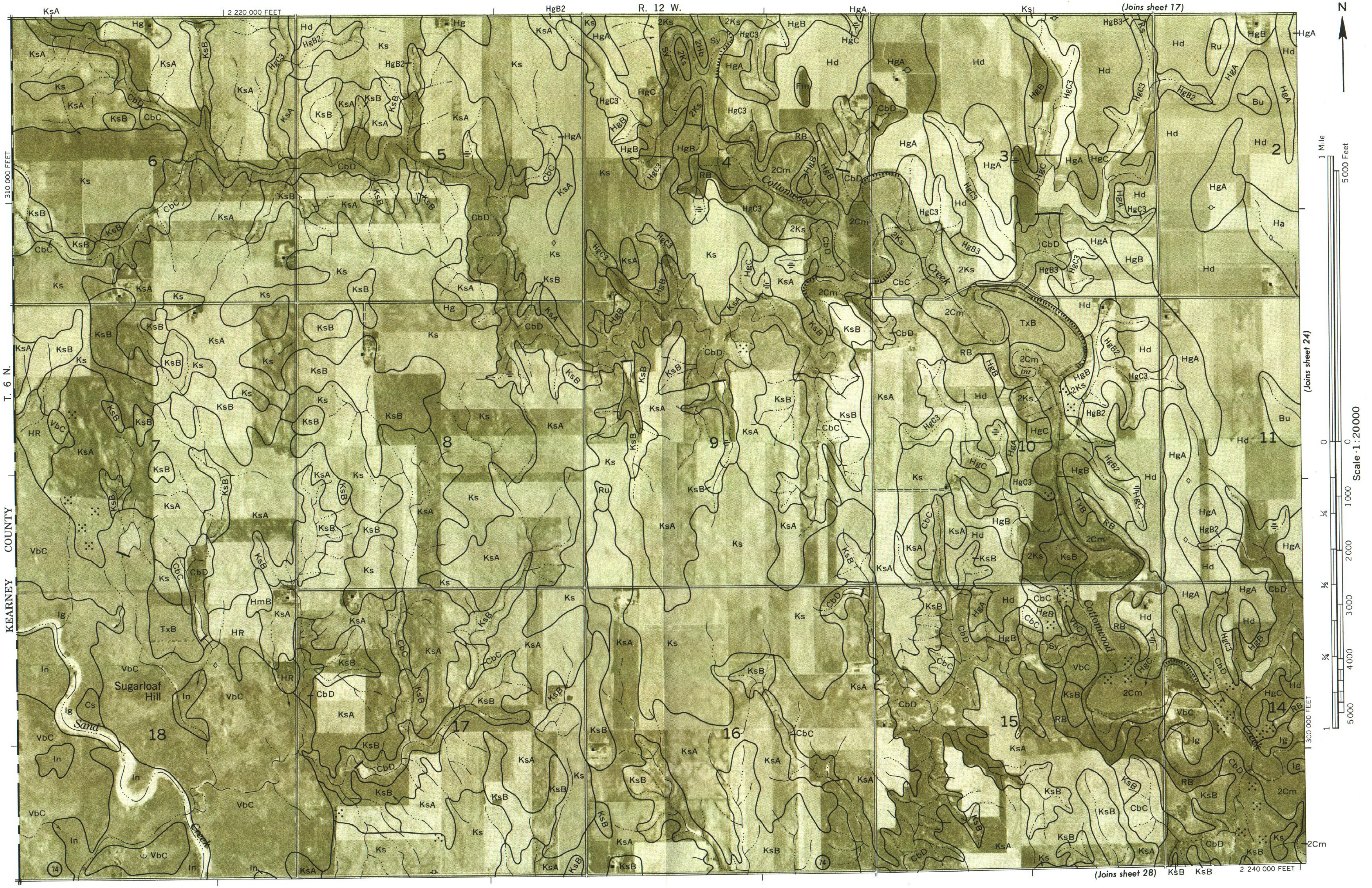
ADAMS COUNTY, NEBRASKA — SHEET NUMBER 23

23



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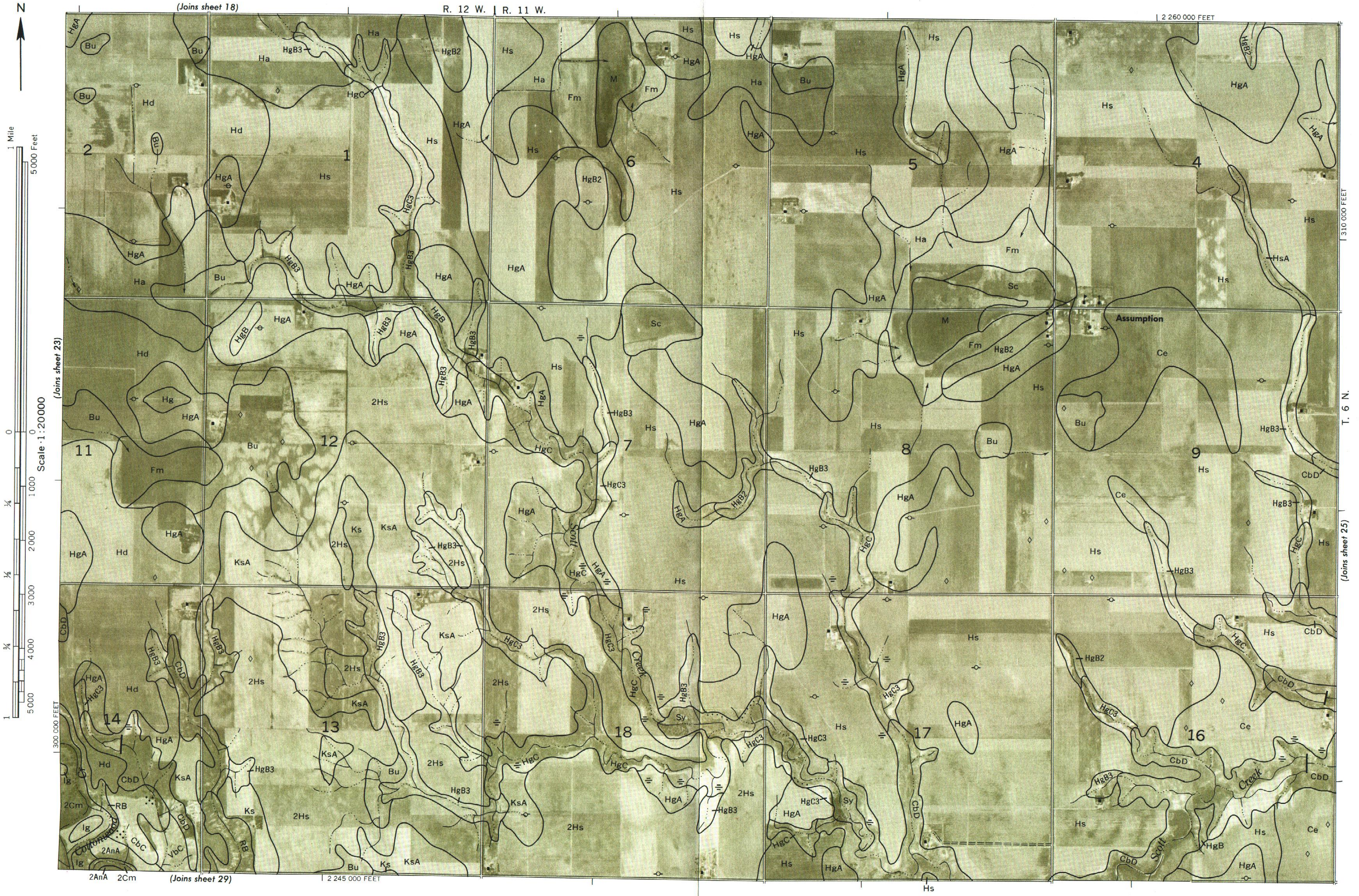

Land division corners are approximately positioned on this map.

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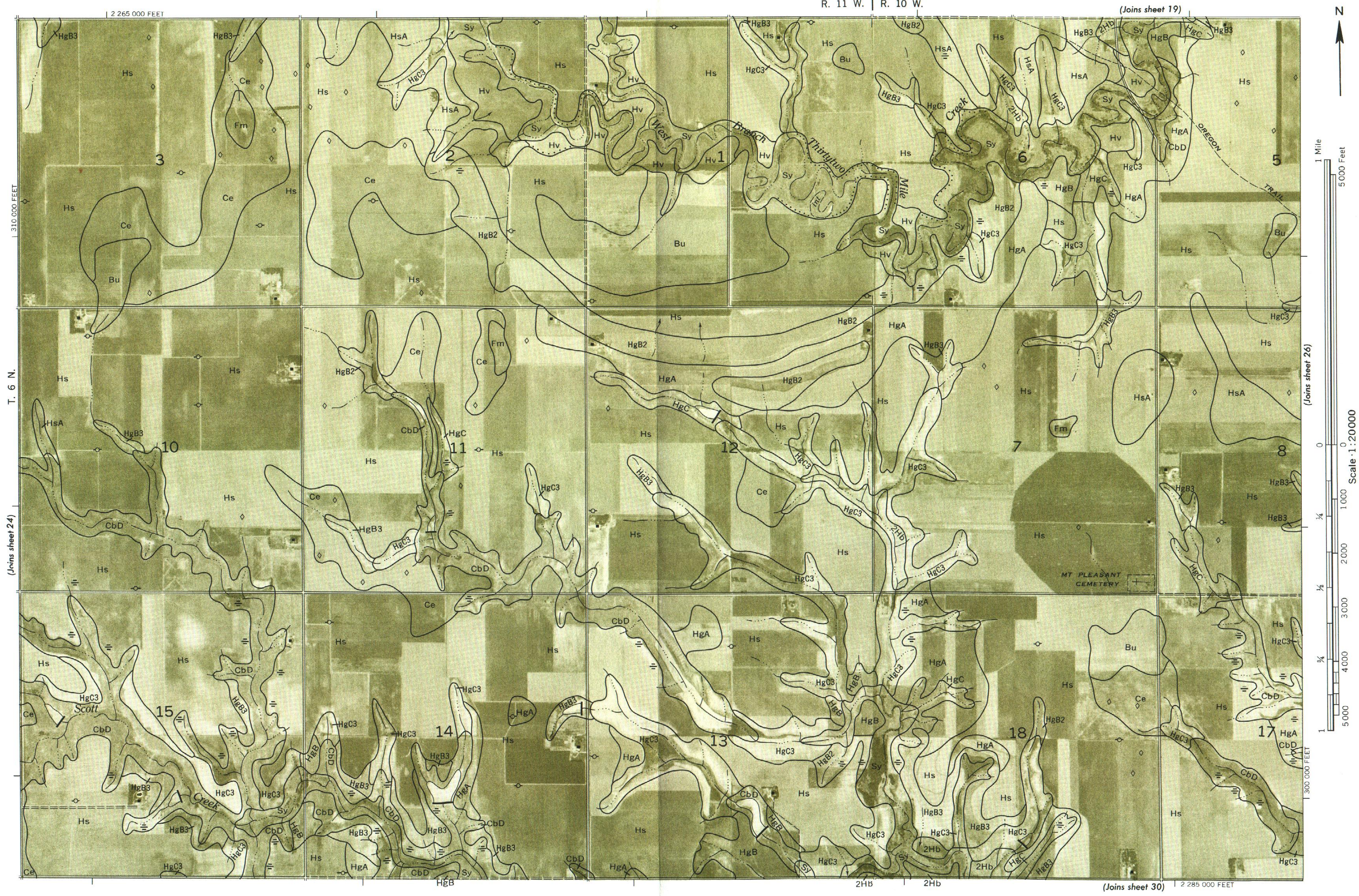

ADAMS COUNTY, NEBRASKA NO. 25

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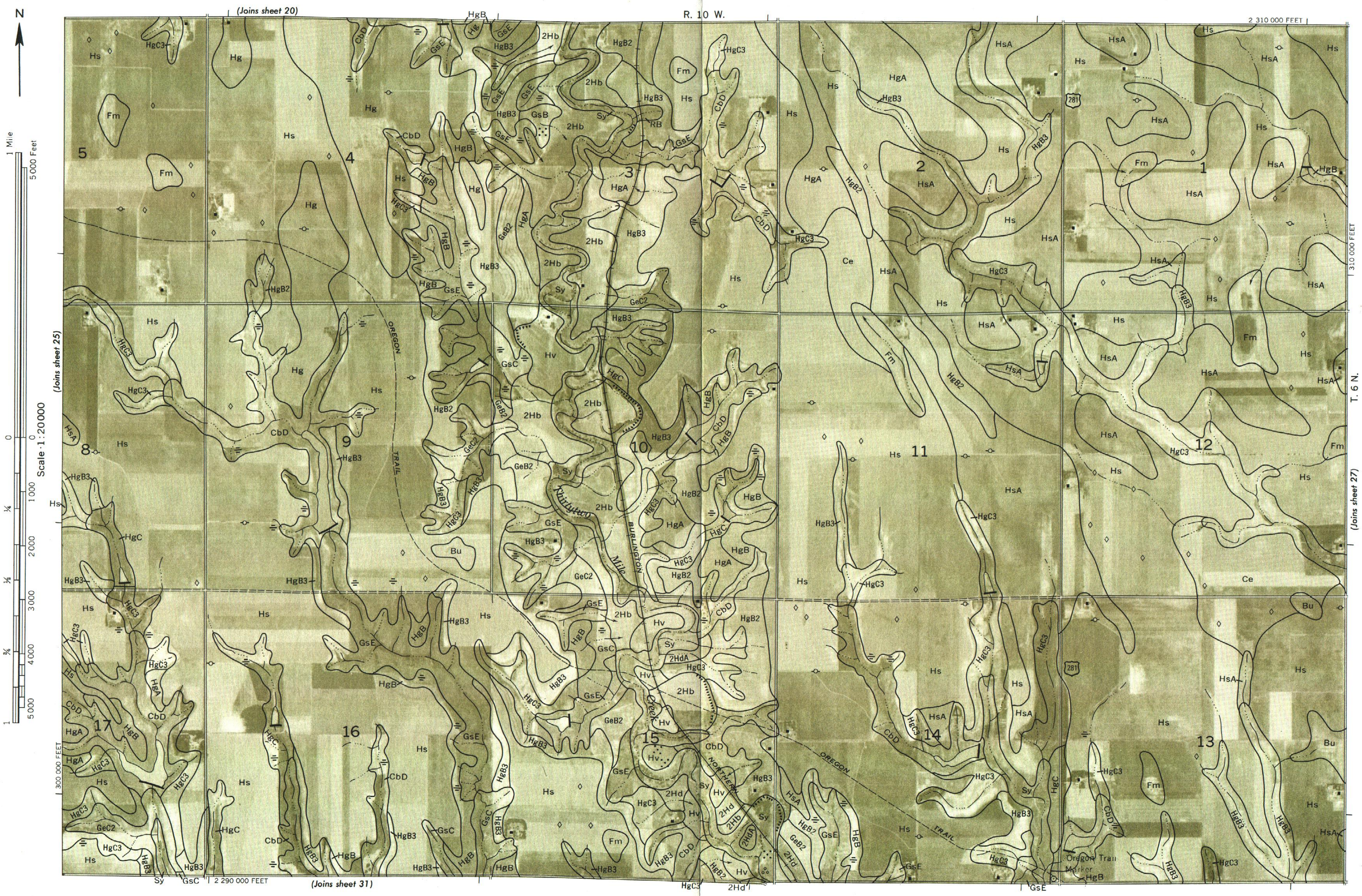

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ADAMS COUNTY, NEBRASKA NO. 27

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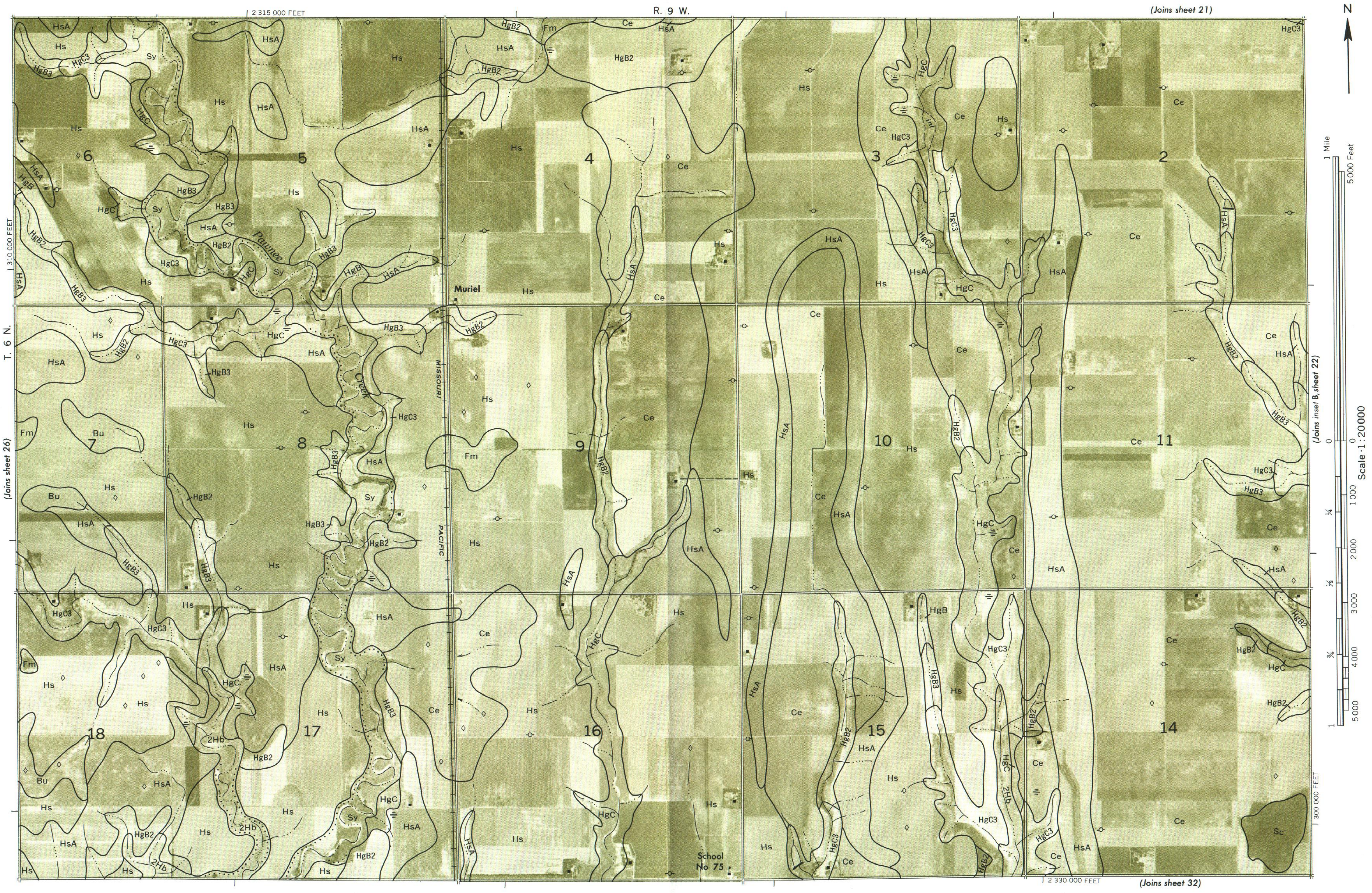
Land division corners are approximately positioned on this map.



ADAMS COUNTY, NEBRASKA — SHEET NUMBER 28

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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ADAMS COUNTY, NEBRASKA NO. 29

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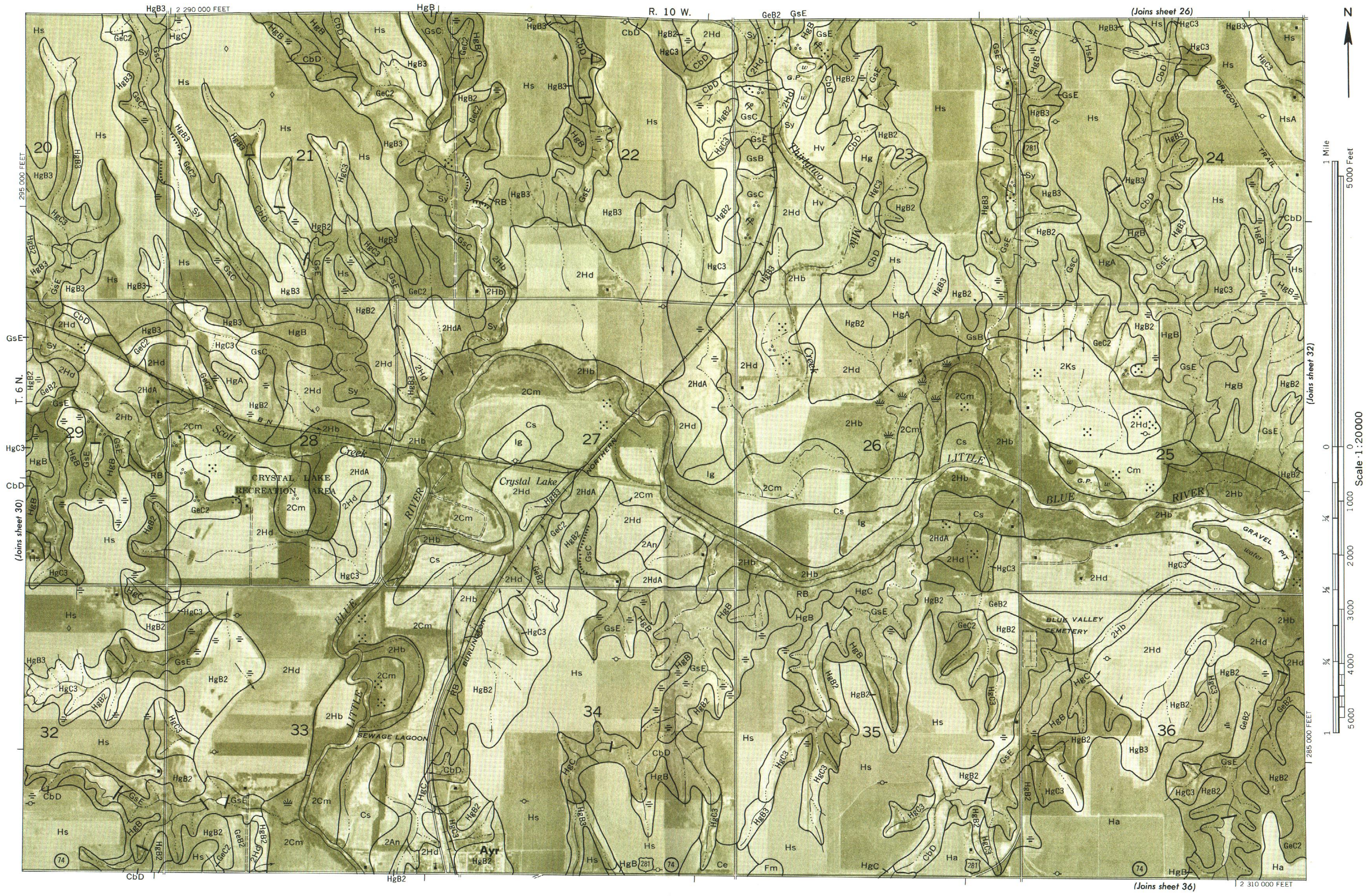

ADAMS COUNTY, NEBRASKA NO. 31

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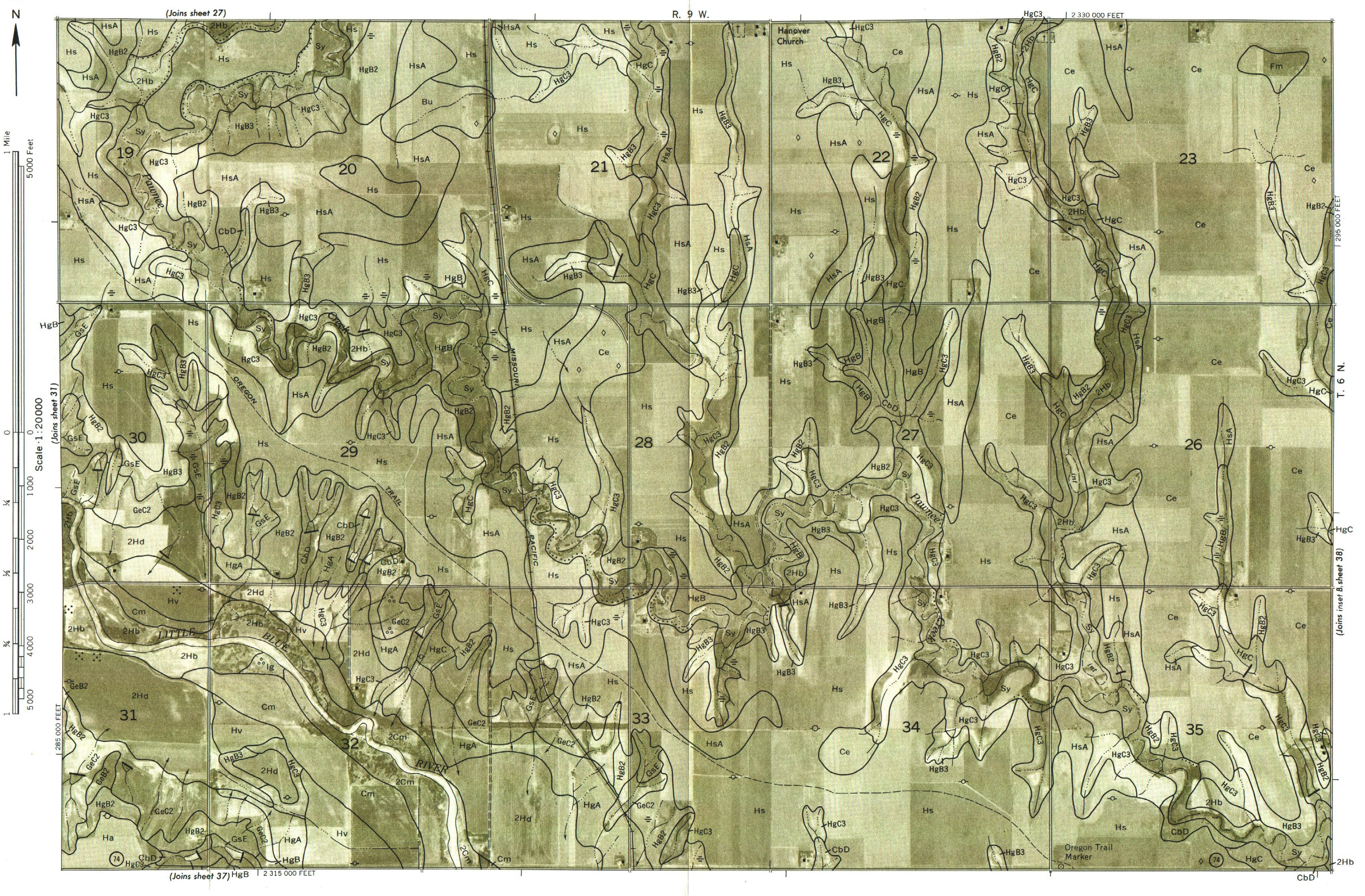
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 32



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ADAMS COUNTY, NEBRASKA NO. 33

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 34

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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ADAMS COUNTY, NEBRASKA NO. 35

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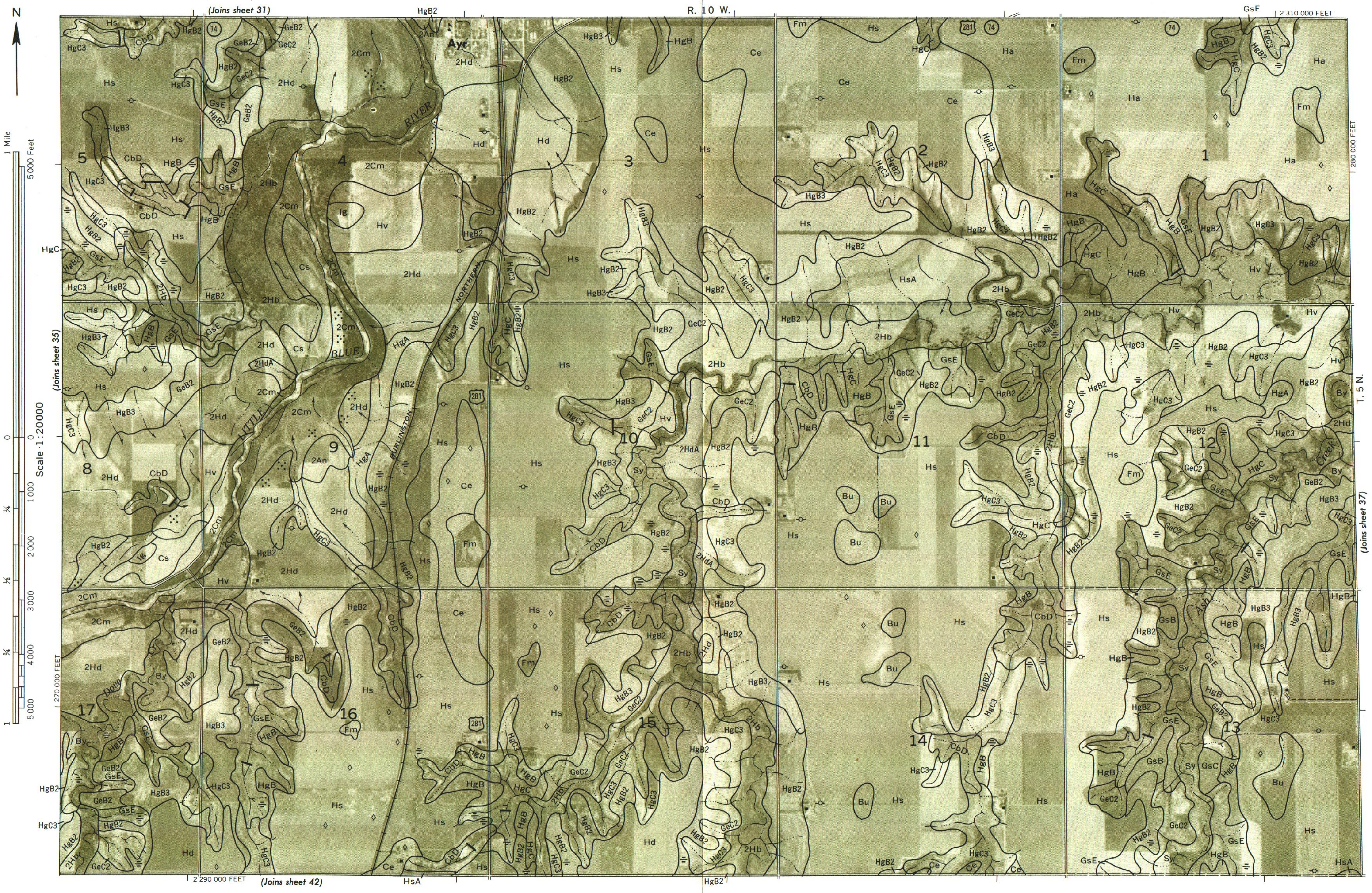
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 36

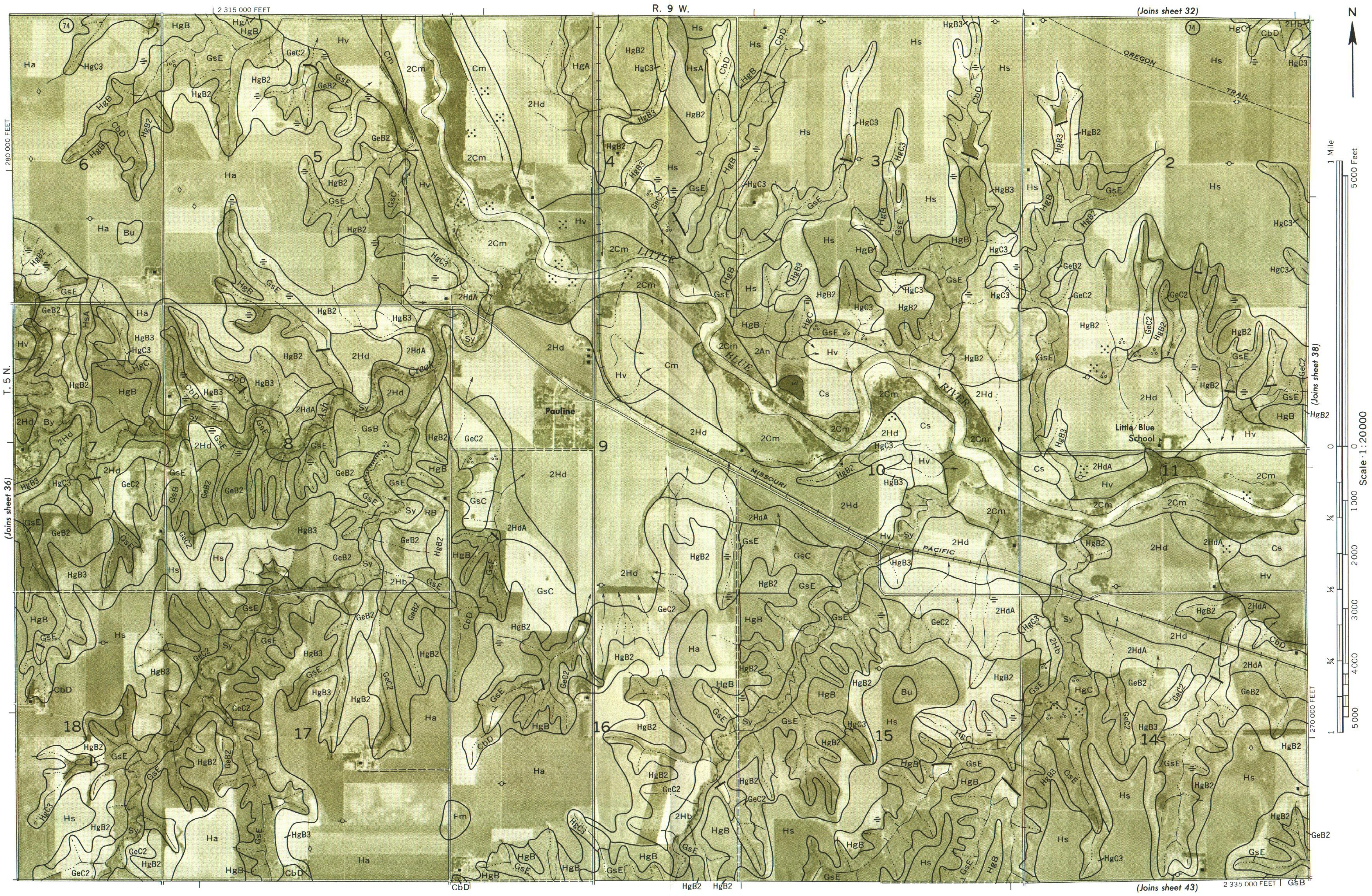


Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

ADAMS COUNTY, NEBRASKA NO. 36



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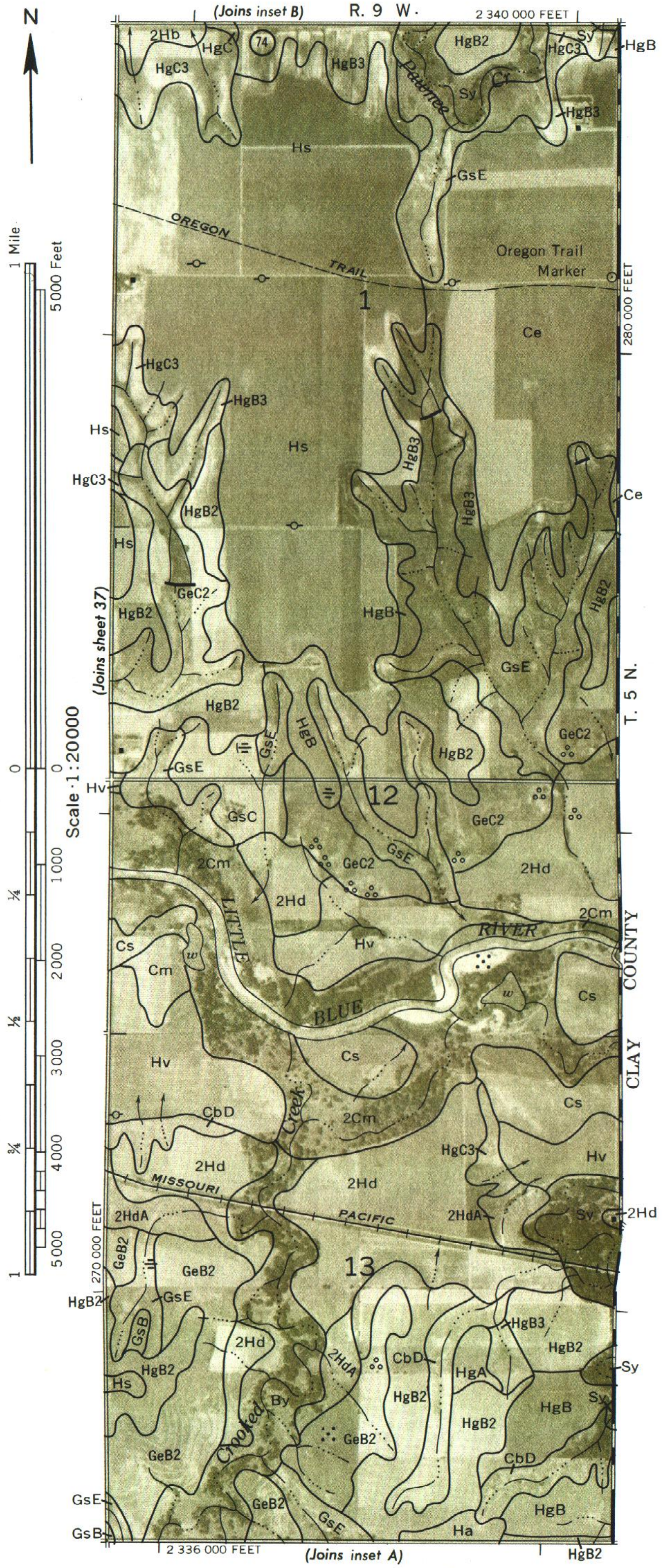
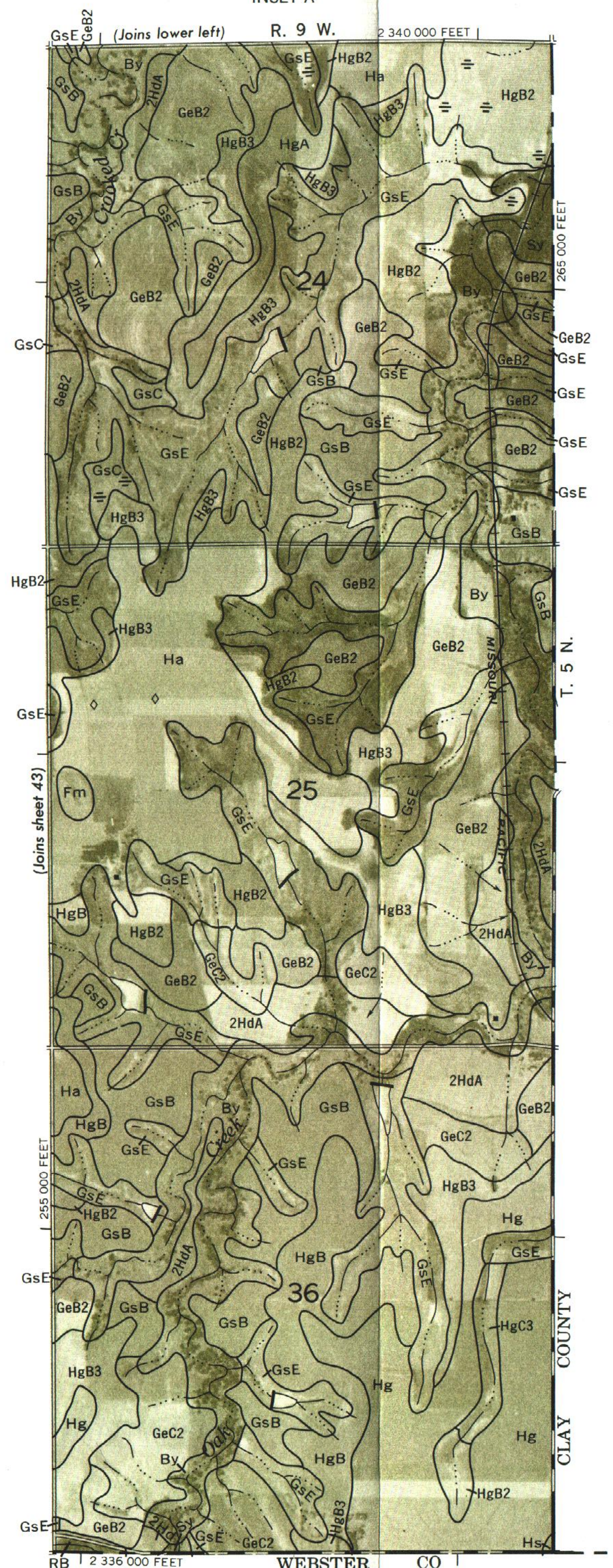
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — NO. 37

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 38

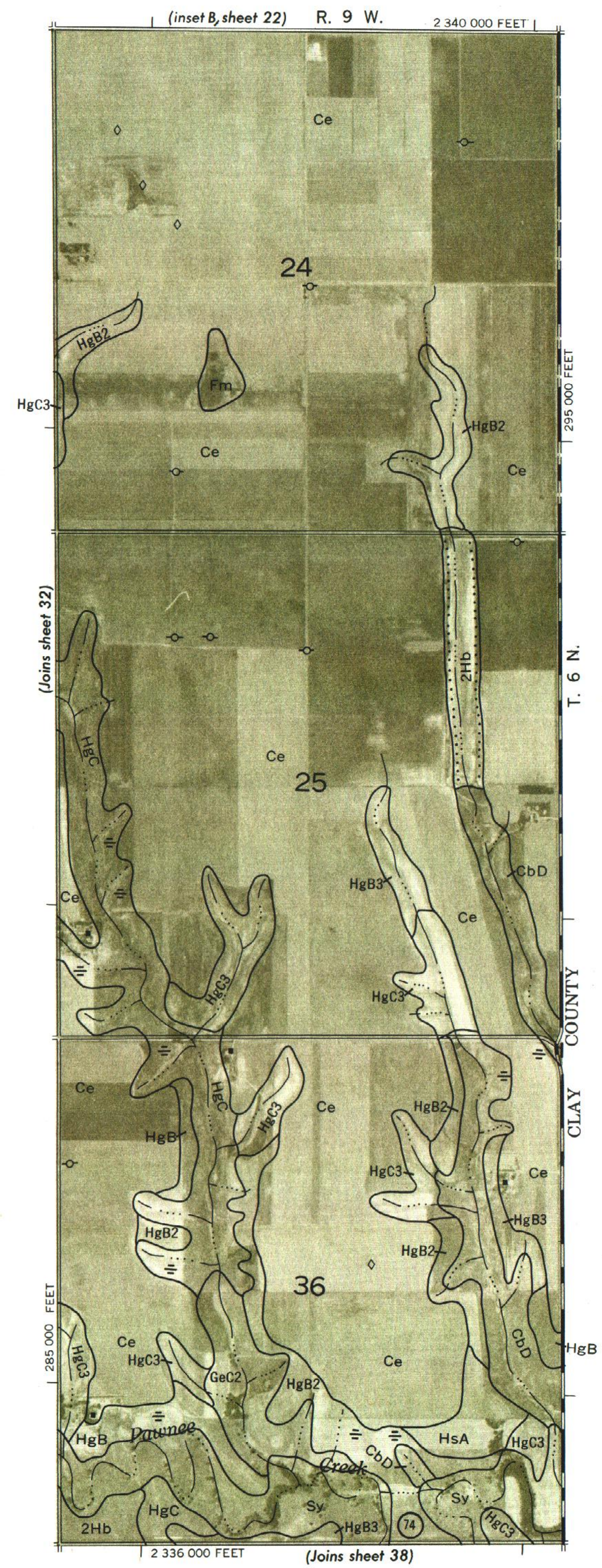


INSET A



4000 AND 5000-FOOT GRID TICKS

INSET B



Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
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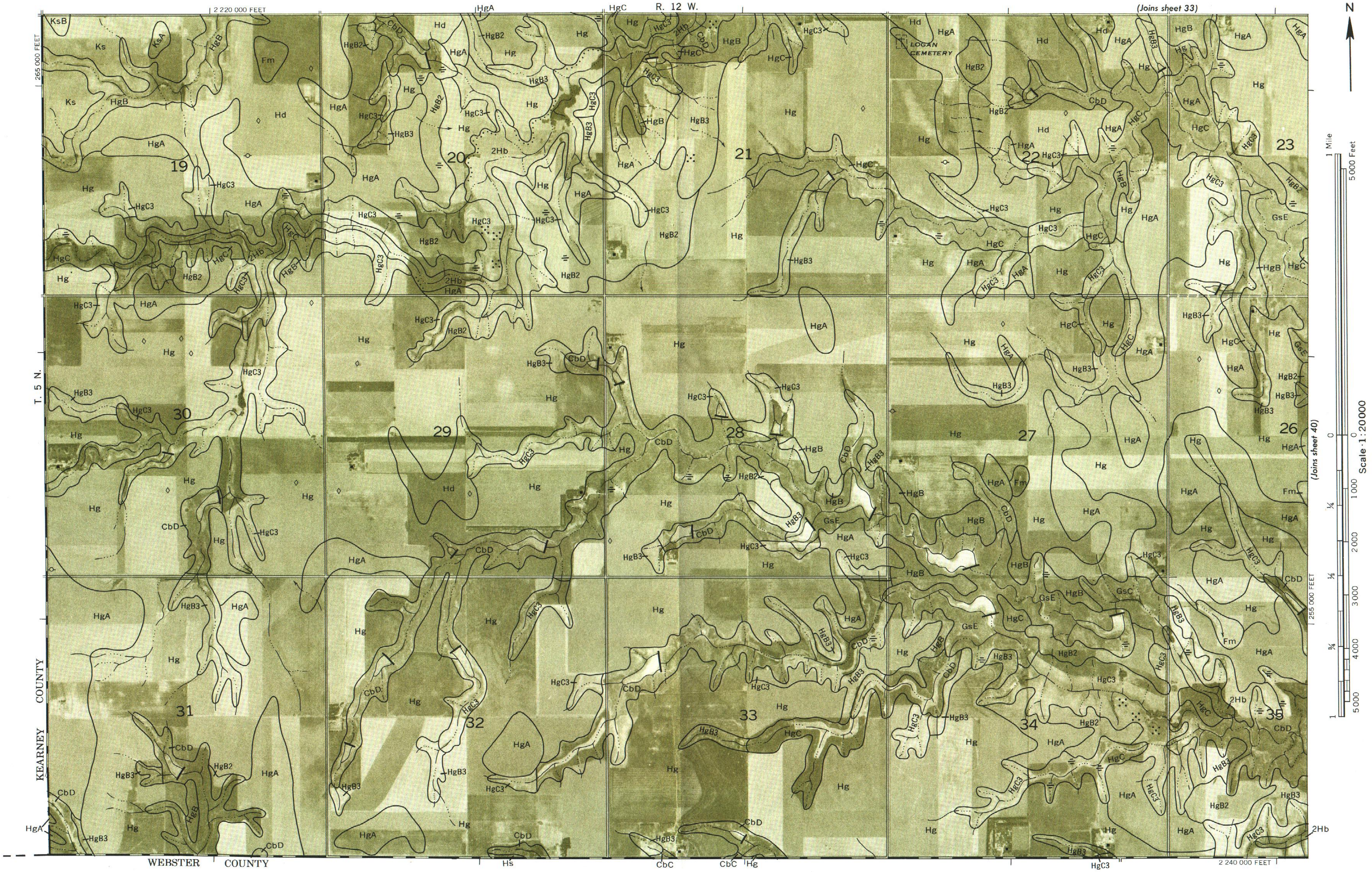

ADAMS COUNTY, NEBRASKA NO. 39

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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ADAMS COUNTY, NEBRASKA NO. 41

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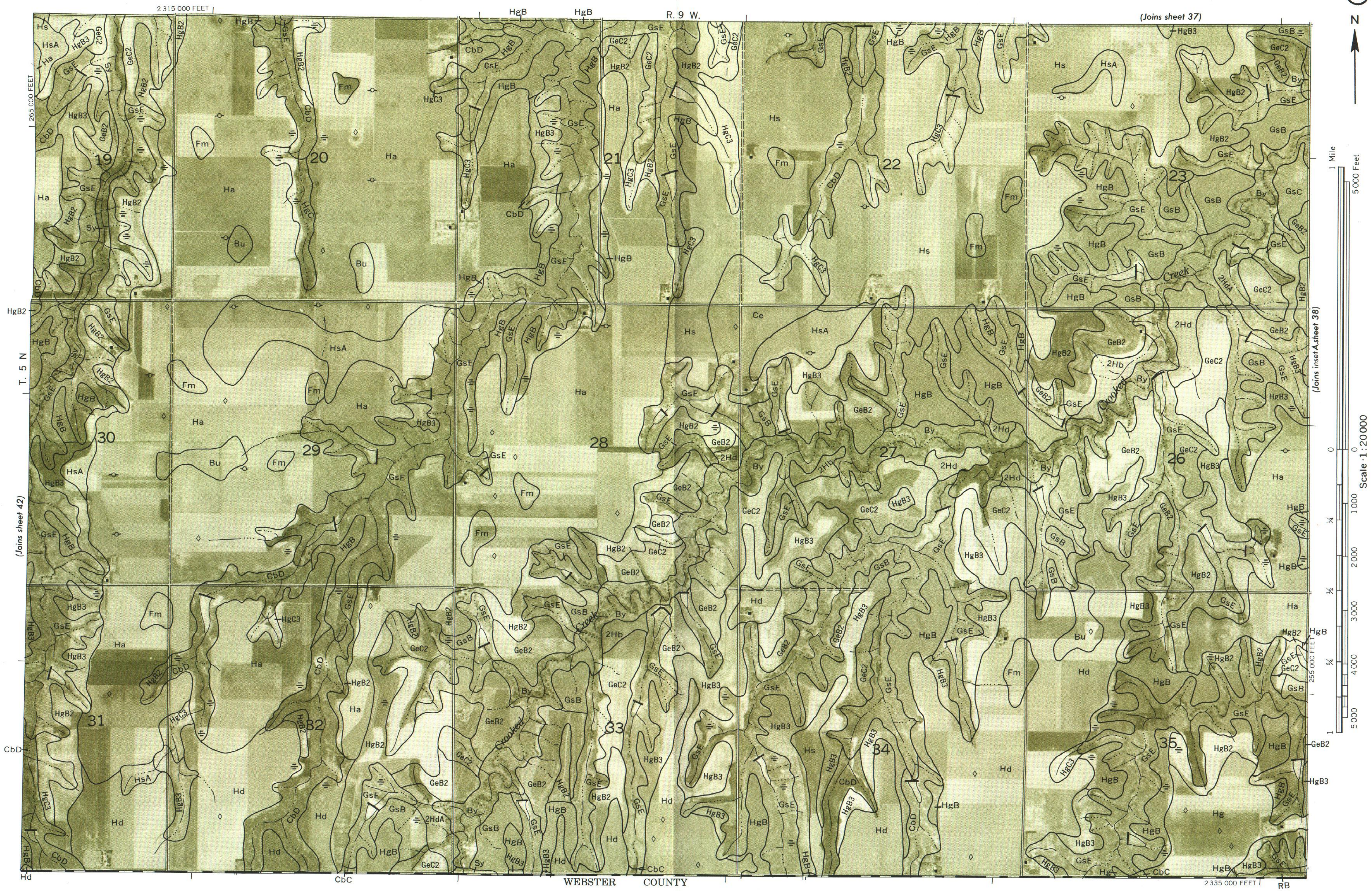
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.

ADAMS COUNTY, NEBRASKA — SHEET NUMBER 42

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



ADAMS COUNTY, NEBRASKA NO. 43

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.
Land division corners are approximately positioned on this map.